MAXIMIZE EFFICIENCY. MINIMIZE PROBLEMS.

Dust Collection Systems Troubleshooting Guide

www.bha.com BHA®

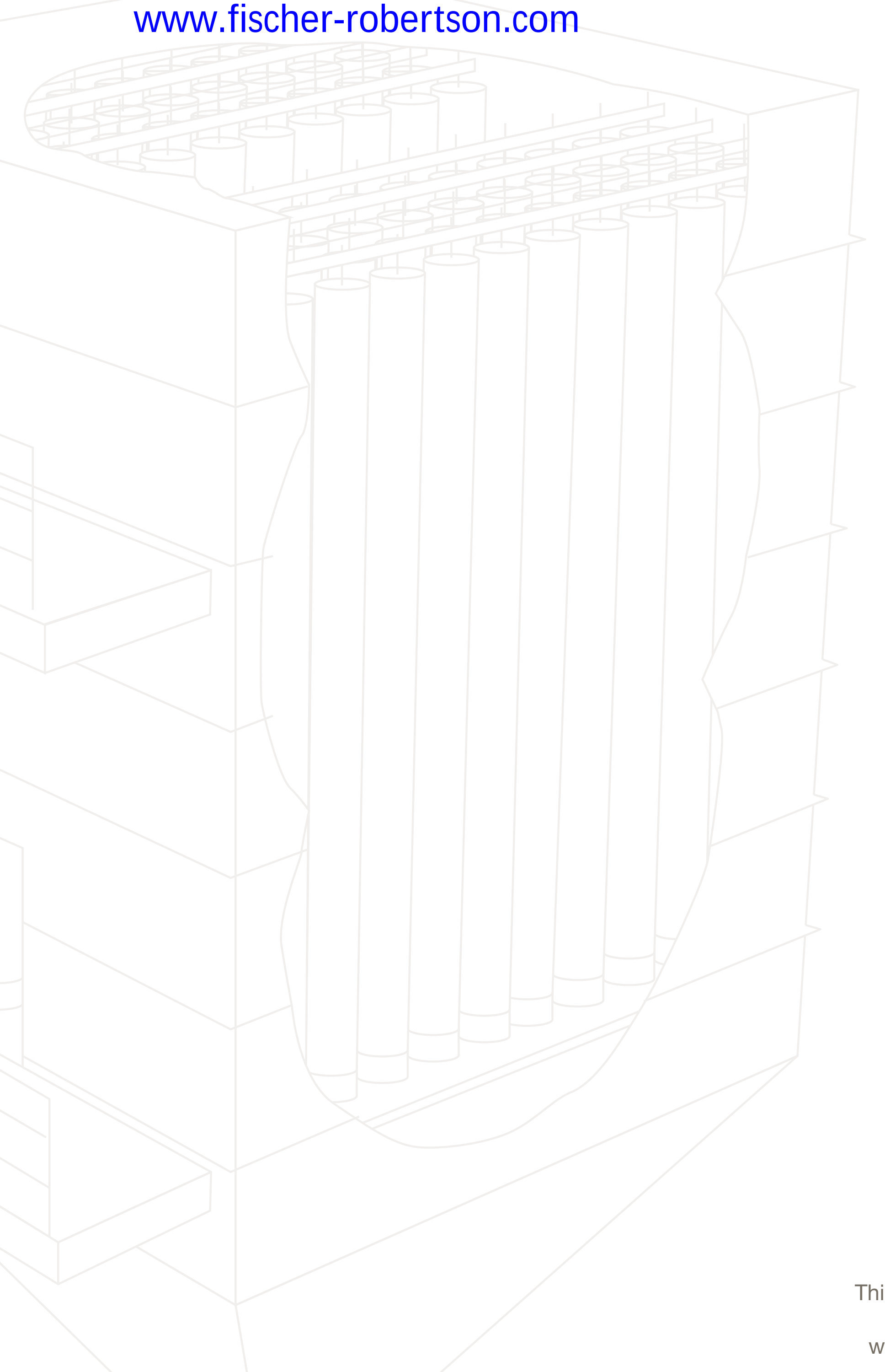
[SIMPLE STEPS TO LONG-TERM SOLUTIONS

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

Parker

ENGINEERING YOUR SUCCESS.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com



Simple changes can often solve persistent baghouse filtration problems, or help a marginal system become more reliable and efficient. This guide will show you how.

That's not just a promise. It's the promise of something better.

CUT COSTS
BOOST EFFICIENCY
IMPROVE RELIABILITY
REDUCE MAINTENANCE

This guide is intended as general reference information only and may not reflect applications, conditions or processes applicable to your specific equipment or facility. The guide is provided without any representations, warranties or guaranties of any kind whether express or implied. Parker Hannifin Corporation specifically disclaims any responsibility for liability based on claims for damage of any type, i.e., direct, consequential or special that may be alleged to have been incurred as a result of contract, in breach of warranty, negligence, or is in other respects responsible for any alleged injury or damage sustained as a result of applying this information.

When performing any troubleshooting work on a system be sure to follow the manufacturer's safety instructions for the system and any site-specific safety processes.

TABLE OF CONTENTS

General Troubleshooting

Cement Industry

Combustion Industry

Metals Industry

Process Industries

References

Dust Collector System Troubleshooting Flowchart

About Us

GENERAL TROUBLESHOOTING

This section presents general troubleshooting measures and operational guidelines that can apply to many industries. Following this information, we have included several industry-specific troubleshooting sections.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

System Design

To begin troubleshooting, you must first know the gas volume required to vent the system. While the system might have operated well when it was first installed, changes made over the years to the control system or the process may have altered the gas volume requirements.

Systems are often modified by the addition/deletion of ventilation points, which can create an imbalance and overload the ventilation system. To determine the gas volume, you will need to evaluate each vent point, then add up the requirements for the entire ventilation system. You should include a safety factor (typically 10%) to account for system leaks and balancing difficulties.

Once you've determined the actual air volume, check the ductwork design and velocity through the system, keeping these points in mind:

- The proper velocity will depend on the dust being conveyed.
- A general rule of thumb for good ductwork design for average industrial dust is to size the cross-sectional area for a velocity. of 3,500-4,000 feet per minute (FPM) (1,067-1,219 meters per minute (m/min.)).
- Ducts with a velocity lower than 3,500 FPM (1,067 m/min.) could allow material to settle out and cause buildup in the duct.
- Ducts with higher velocities than 4,000 FPM (1,219 m/min.) can lead to abrasion of the ductwork.
- Common ductwork design problems include poorly designed branch entries, poorly designed elbows, and size variations that hamper airflow and/or cause accelerated wear.

The following reference formulas are important in evaluating the design criteria of your ductwork:

Total CFM = Velocity (FPM) x Duct Area ($ft.^2$)

Velocity = $4{,}005\sqrt{VP}$ for Standard Air
(Standard Air is 70°F (21°C)
@ sea level.
VP is velocity pressure in inch WC.)

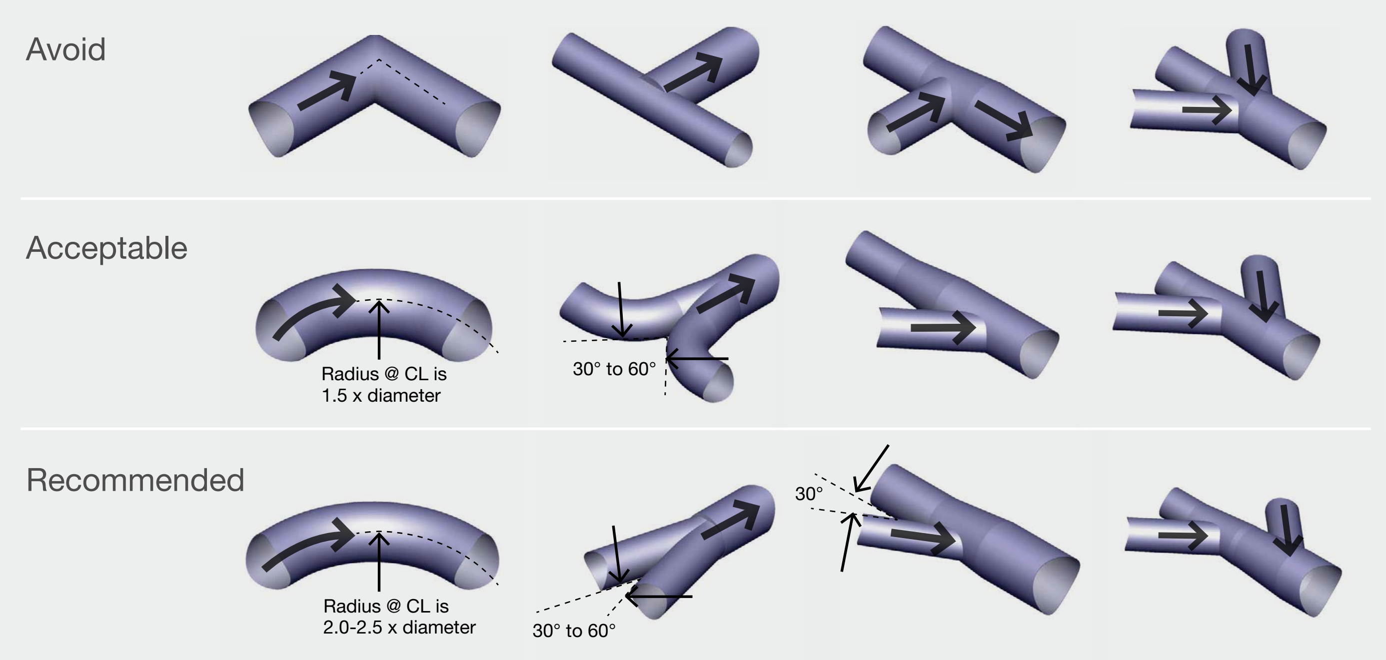


Figure 1. *Elbow, joint and branch duct designs that promote efficient airflow.**

TABLE OF CONTENTS
ADDITIONAL TOOLS
GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

Pickup Points

Pickup points should be designed to provide adequate ventilation of the dust point, while minimizing the amount of product introduced into the dust collection system. Improperly designed hoods tend to increase grain loading to higher levels than the collector was originally designed to handle.

Problem: Belt Conveyors

Belt conveyor ventilation systems frequently have poor design features, including:

- Improper placement of the vent enclosure over the belt
- Poorly designed duct connections to the vent enclosure
- Poorly designed belt covers (too close to the material)
- Improper pickup point hood sizing and design
- Improper placement of the belt cover skirting, allowing it to extend into the material

Solution

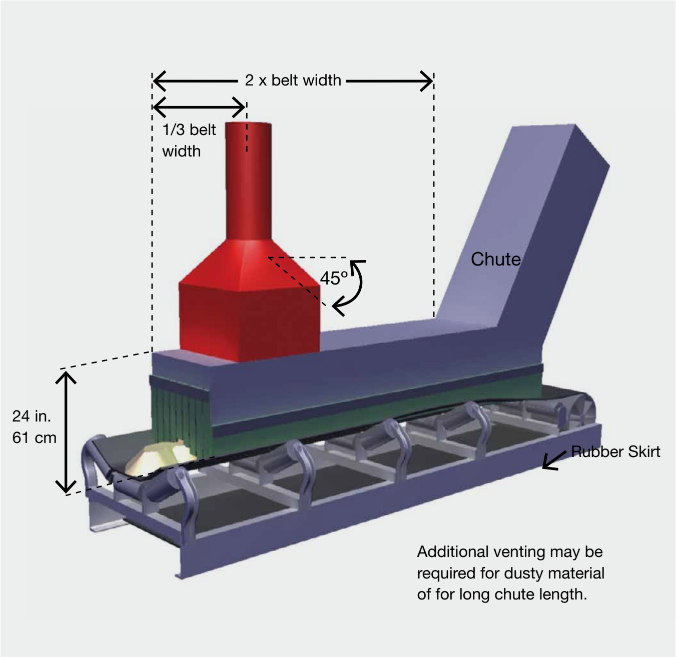
The belt cover enclosure should be designed to conform to the practice recommended by the *Industrial Ventilation Manual*. The height of the enclosure roof should typically be 24" (610 mm) from the top point of the belt to the top of the enclosure. The length of the enclosure should be a minimum of two times the belt width from the discharge chute. The belt enclosure skirt located at the discharge end of the enclosure should be 2" (50 mm) above the profile of the material on the belt.

General air volume is 350–500 CFM per foot of belt width (9.9–14.2 m^3/min.). If the material is a dusty type and the fall onto the belt is greater than 3 feet (0.91 m), add another 700 CFM (19.8 m^3/min.) vent point at the back of the enclosure.

NOTE: Horizontal collectors are proving to be the best way to vent a belt conveyor, since they eliminate ductwork, reduce static pressure and keep the material confined to the belt conveyor area. See page 29.

Results

These adjustments should reduce the quantity of material introduced to the collector, resulting in lower collector pressure drop, greater gas flow and better venting of the system (see Figure 2).



Additional venting may be required for dusty material of for long chute length.

Figure 2. *Improved belt conveyor hooding.**

Figure 3. *Horizontal collector with easily replaceable pleated filter elements.*

Problem: Air Conveyors

On an air conveyor, inappropriate design and location of vent points can pull excess product into the dust collector.

Solution

Recommended ventilation of the air conveyor is accomplished by installing a vent pipe on the upper casing. The vent velocity at the pickup should be low to minimize the amount of product pulled into the venting system. To achieve this, the vent duct should be located on a box sitting directly on top of the air conveyor casing (see Figure 4). The box should be square, with the same dimensions as the conveyor in both height and width, and have a 45° slope on top that transitions to the conveying duct diameter. The location(s) of the vent point(s) are determined by the quantity of dust and conveyor design. General air volume is 10 CFM per square foot of air conveyor fabric (3.1 m^3/min./m^2).

NOTE: Air conveyor vent collectors (ACVC) with pleated filters are now available to attach to the top of the air conveyor, which keeps the dust confined to the conveyor and eliminates the need for hoods, ductwork, etc. See page 28.

Results

Installation of the hood or ACVC decreases velocity at the pickup point on the air conveyor, reducing the dust load to the collector. This can lower the system's pressure drop, ensuring more efficient venting and longer filter life.

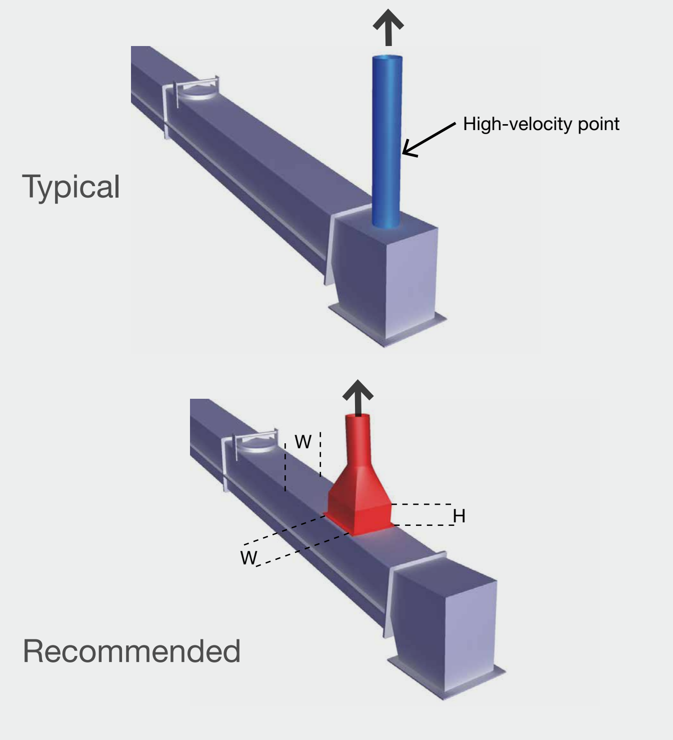


Figure 4. *Hood fix for air conveyor.**

**From ACGIH®,* Industrial Ventilation: A Manual of Recommended Practice, *28th Edition. © 2013. Reprinted with permission.*

Problem: Bucket Elevators

Bucket elevators transport material vertically, then discharge it from the bucket as it rotates over the head pulley. Vent points in the discharge chute are often placed in an area of material transfer, increasing the product load into the ventilation system.

Solution

By properly locating the vent points on the elevator housing between the belts or chains of the bucket elevator, the vent point is moved out of the material flow area (see Figure 5). General air volume is 100 CFM per square foot of cross section of the elevator (31 m^3/min./m^2). If the elevator is over 30 ft. (9.1 m) tall, you will need to vent it at the top and the bottom, but use 50 CFM per square foot for each vent point.

Results

The air volume handled remains the same, but the velocity at the vent point is lowered, reducing the amount of product pulled into the ventilation system. Conveying less material into the ventilation system reduces duct wear, filter wear and material recirculation.

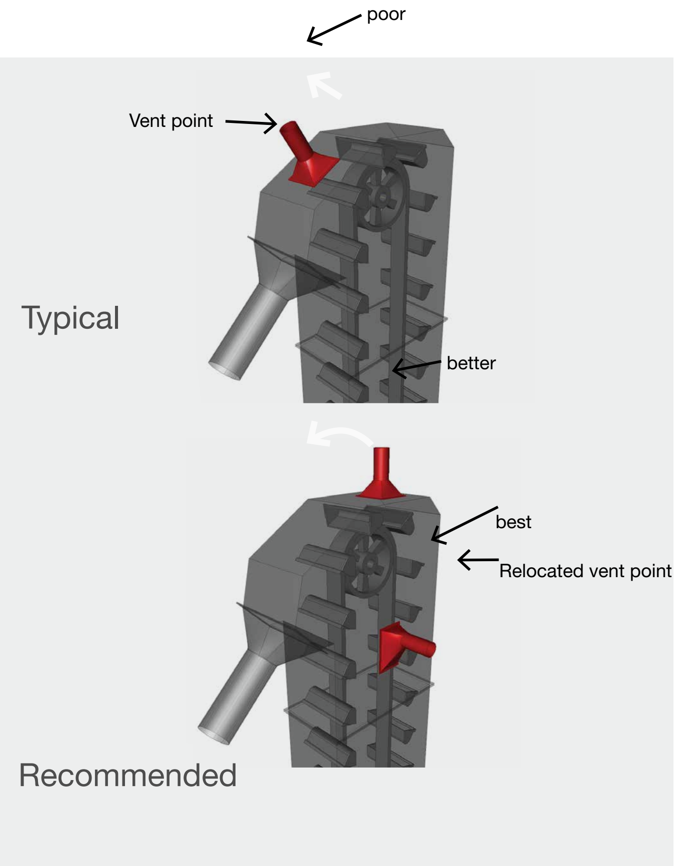


Figure 5. *Improved elevator vent placement.**

TABLE OF CONTENTS
ADDITIONAL TOOLS
GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

Pulse-Jet Collectors

In pulse-jet collectors, the cleaning function not only removes the collected dust, it rearranges the remaining dust cake structure on the bag, changing the differential pressure. In a unit with high upward gas velocities, the submicron dust can become separated from the rest, producing a very dense dust cake that increases airflow resistance and raises differential pressures.

Improving Pulse-Jet Collector Performance

Use the Most Effective Pulse Sequence

The pulsing sequence can play an important part in minimizing material recirculation. Pulsing the rows in order can cause the submicron material to migrate to the cleaned row. Staggering the pulsing order so the recently cleaned rows are separated from those yet to be cleaned can improve the dust cake, resulting in better filtration. A staggered cleaning cycle can also reduce the cleaning frequency, increasing filter life (see Figures 6 and 7).

Adjust the Pulse Cycle

The cleaning cycle for standard high-pressure, low-volume pulse-jet collectors should be adjusted so the pulses are short and crisp to create an effective shock wave in the bag. The duration should generally be 0.10 to 0.15 of a second, depending on the manufacturer's recommendations. (Other styles such as low-pressure/high-volume and medium-pressure/medium-volume pulsing use different settings and should be examined individually.)

Correct pulse cleaning frequency is also vital to proper dust cake retention. This frequency can vary from 1 to 30 seconds or more. You should adjust the frequency using the setting on the timer board or PLC until the differential pressure across the collector averages 3"–6" (75–150 mm) WC, depending on the type of filter used. To ensure proper cleaning frequency, you could install an automatic clean-on-demand system utilizing a pressure switch such as a Photohelic* gauge. This type of system automatically begins its cleaning cycle when the high differential pressure set point is reached and stops when it cleans down to the low differential pressure set point. This arrangement can reduce compressed air usage. The differential pressure set points should be no more than 0.5"–1.0" (12.5–25 mm) apart.

On pulse-jet collectors, the pulse frequency can be increased. However, the next pulse should not be programmed to fire until the compressed air pressure has recovered, so each row is cleaned with the same pulse force. The air pressure recycle time depends on the capability of the compressed air system and the size of the pipe to the header tank. This pipe should be large enough to repressurize the header quickly enough for the pulse-jet collector to operate effectively. A 1.5" (3.81 cm) feed line is typical.

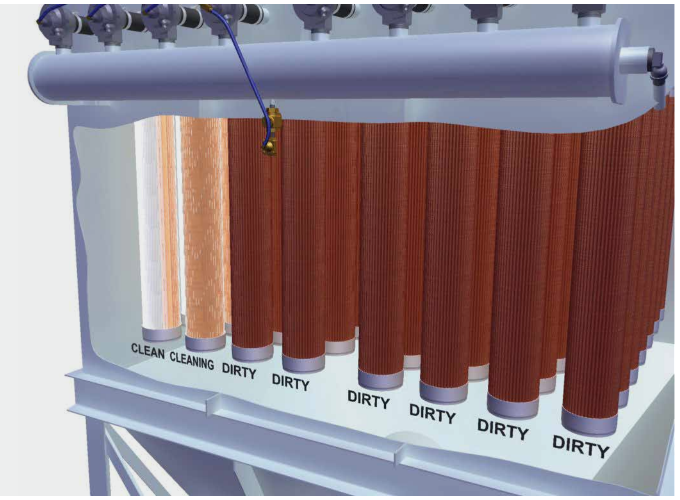


Figure 6. *Typical pulse-jet row cleaning sequence.*

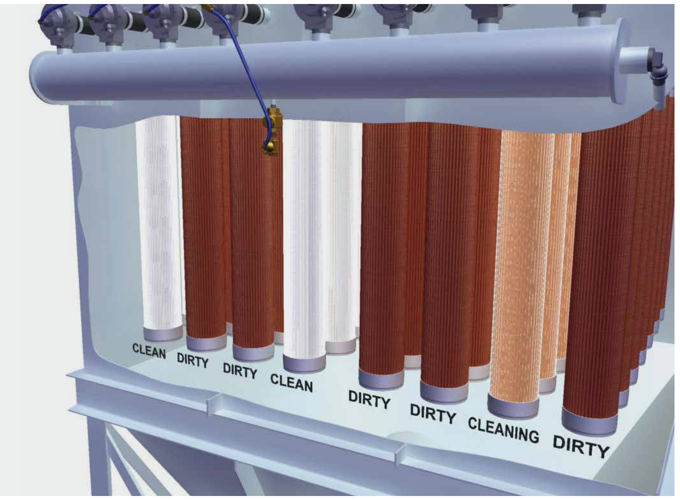


Figure 7. *Recommended pulse-jet row cleaning sequence.*

**Trademarks property of their respective owners.*

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS
ADDITIONAL TOOLS

Troubleshooting Pulse-Jet Cleaning Systems

Check the Pulse Valves
Pulse valve malfunctions are usually caused by diaphragm failure or dirt, oil and/or moisture getting into the valve body. You can identify these problems by disassembling the valve and inspecting it.

Before checking the valves, verify that the tubing and fittings between the pulse valves and the solenoid valves are not leaking and that the tubing is connected to the inlet port on the solenoid valve.

Prior to servicing the pulse valve, check the timer board and the solenoid pilot valve for proper operation. If either is malfunctioning, refer to the troubleshooting flowchart at the end of this guide.

Instrumentation
Check the pressure tap lines to the Photohelic or Magnehelic gauges for blockage. Often the tap lines from the dirty air plenum are clogged with dust preventing proper readings.

Check Can Velocity
Pulse-jet collectors typically clean on-line and have inlets below the filters. In this case, can velocity may be a problem (see glossary). Can velocity is most critical when the dust being collected is light density (≤ 35 lbs./ft.^{3} (560 kg/m^3)). Can velocities that are too high (≥ 250–300 FPM, depending on the dust) can cause high pressure drops.

One solution is to install BHA® PulsePleat® filters. Pleated filters have more filter area than traditional bags, allowing you to use fewer filters. This creates more open area for airflow, which reduces can velocity. Changing the inlet to a point above the filter bottoms may also remedy the problem.

Inspect the Cages
We recommend thorough cage inspections any time a new bag is installed, using the guidelines in Table 1. The most common problems are bent and damaged cages that cannot properly support the filter bag. Another problem is rusting and pitting of cages in corrosive environments, where the corroded areas can abrade the fabric as it flexes during the cleaning cycle. Cage bottom pans with sharp edges can cause similar damage.

Check for Correct Bag-to-Cage Fit
The fit between the bag and cage is critical for proper pulse-jet filter performance. Filters that are too loose or too tight will severely limit collection efficiency and lead to premature failure. See Figure 12 and Table 2 to determine the amount of excess fabric (the “pinch”) to allow for various fabric types.

Filter Bag Installation for Pulse-Jet/Plenum Pulse Dust Collection Systems

Pulse-jet and plenum pulse systems collect dust on the outside of the filter. Dust-laden gas floods the baghouse and clean air exits through the inside of the bag, while the dust particles collect on the outside filter surface. A support cage prevents bag collapse during filtration and aids in redistributing and cleaning the dust cake.

Construction of the filter is critical to its life. Examine the current bag to determine if recurring wear indicates a need for wear cuffs or similar features in high-abrasion areas. When ordering filters, it’s important to consider the size and style of cages, tubesheet holes and filter specifications. You should use the actual dimensions from your collector to assure the filter will seal properly in the tubesheet.

Correct filter bag installation is important to maximize the life of the fabric. The recommended procedure for bags in pulse-jet collectors is to position all the bag seams facing in the same direction. This provides a reference point that helps to identify problems that result from inlet abrasion (see Figure 8). For example, knowing filter failures always occur on the side opposite the seam might help you determine the cause.

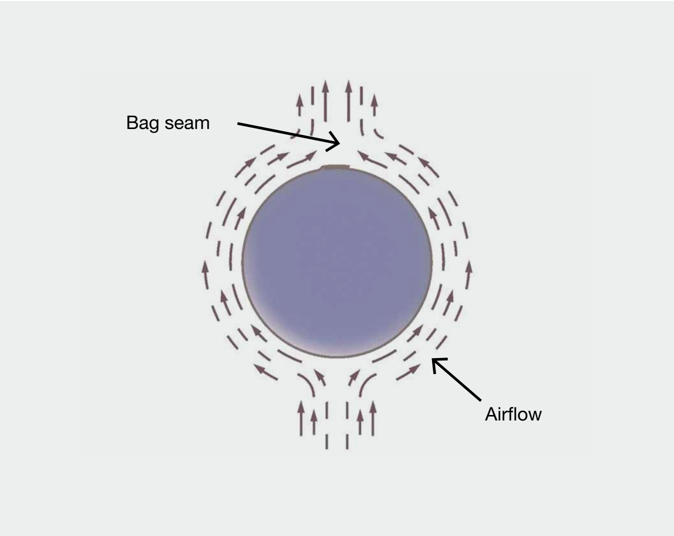


Figure 8. In pulse-jet collectors, all bag seams should face the same direction.

Damage	Cause	Solution	Options
Bags have internal abrasion marks along vertical wires.	1. Cage wires are deeply pitted by excessive corrosion, or 2. Bag is oversized.	1. Replace with new galvanized steel cage, or 2. Replace with correct-sized bag.	1a. Use a mild steel cage if chloride and moisture (HCl) are present, or 1b. Use an epoxy-coated cage, or 1c. Convert to stainless steel cages.
Cuts and/or internal damage at the bottom of the bag where it contacts the edge of pan.	Sharp pan edge.	Use cage with rounded edge pan.	Increase the number of vertical wires to reduce amount of fabric drawn between wires across edge of pan.
Cage body has collapsed; broken welds and bent wires have caused bag wear points.	1. Cage has been weakened by corrosion, or 2. Pressure exceeds cage strength, or 3. Rough handling by maintenance crews.	1. Replace with standard cage, or 2. Change operating conditions to reduce differential pressure, or 3. Retrain maintenance.	1. Replace with a coated or stainless cage, or 2a. Increase the number of cage rings, or 2b. Make cage from heavier gauge wire, or 3. Contract maintenance.
Bag failure caused by excess fabric slack pinch above top ring or below bottom ring.	Cage is tapered or bowed between the ring and the pan (hourglass).	Design cage with minimal taper (larger pan or top).	Change ring spacing to minimize taper or bowing.
Flex line failures between the vertical wires.	Bags are not adequately supported by cages.	Replace with cage providing more support (20 vertical wires and/or closer horizontal ring spacing).	1. Convert from 10- or 12-wire cage to 20-wire cage design, or 2. Reduce ring spacing.
Bags are difficult to remove from cages.	Corrosion causes rough surfaces that increase friction between the bag and the cage. The cage wire and fabric can chemically bond.	Replace all cages with new standard cages.	1. Use coated or stainless steel cages, or 2. Convert to omni-top cages so snapband bags and cages can be removed as a single assembly.

Table 1. *Bag and cage damage inspection guide.*

Bags with flanges or cuffs that fold over the top of the support cages should be checked for smoothness around the edge to prevent leakage and bag abrasion (see Figure 9).

Figure 9. *Check for smoothness around the edge when bag flanges or cuffs fold over the top of the cages.*

On bottom-load bags, you should place the seam 90° from the split or gap in the cage collar. Position the clamp opposite the split and fit it into the cage's groove (see Figure 10).

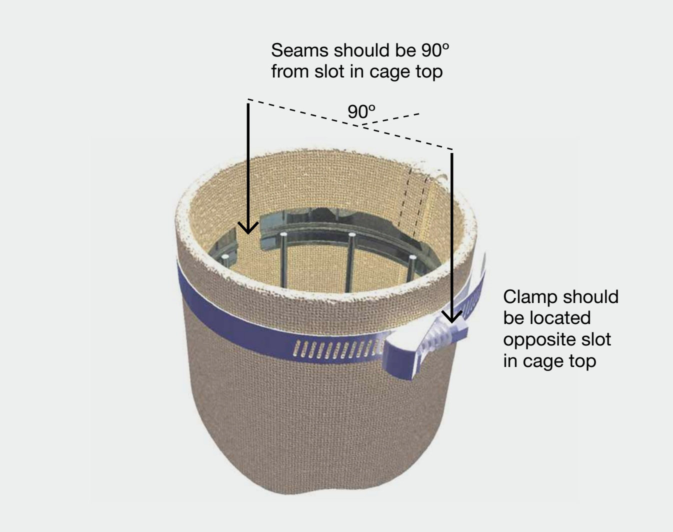


Figure 10. *Correct positioning for bottom-load bags.* Snapband bags for top-access pulse-jet units should also be installed with the seams facing in the same direction to makeit easier to identify and troubleshoot problem areas.

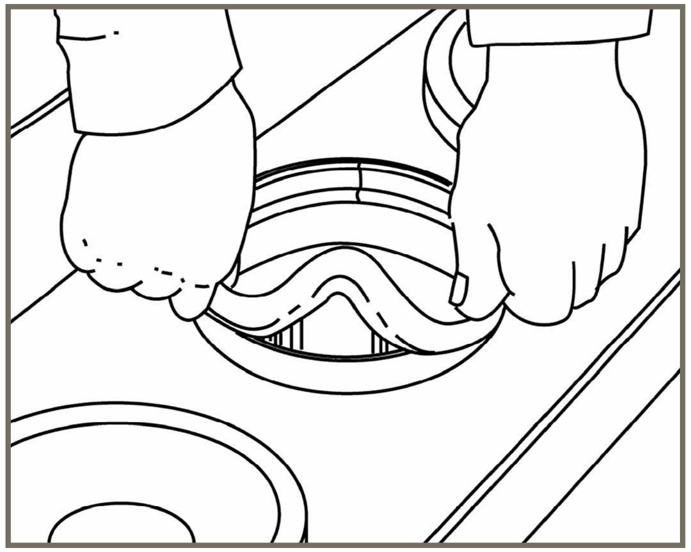


Figure 11. *To properly install a snapband filter bag, bend the snapband into a kidney shape and place the grooved gasket into the tubesheet hole, positioning the seam first. Let the snapband expand into place. You should hear a sharp popping noise when the band is properly seated around the circumference of the tubesheet hole.*

Use caution when installing the filter bag, do not let your fingers fall between the snapband and the tube sheet hole when snapping the bag.

The fit between the bag and cage is critical for pulse-jet filters to perform properly. Filters that are too loose or too tight will have severely limited collection efficiency and may fail prematurely. See Figure 12 and Table 2 to determine the amount of excess fabric (the “pinch”) to allow for various fabric types. You should also evaluate the number of wires in the cage based on its diameter.

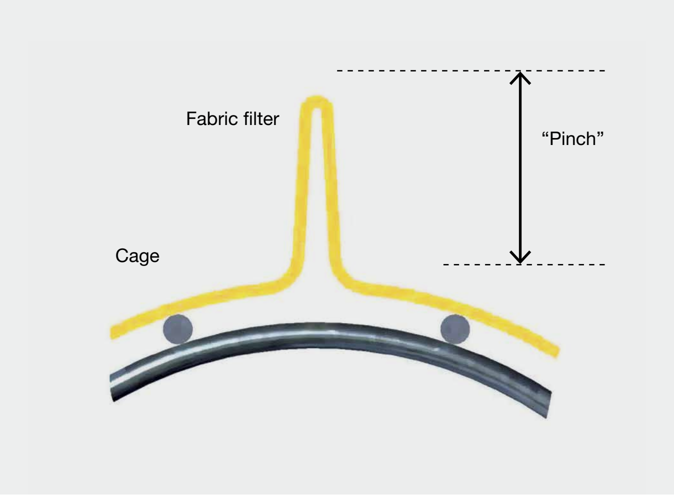


Figure 12. *“Pinch” is calculated by subtracting the actual cage circumference from the bag circumference, then dividing the result by 2.*

Fabric	Pinch	Recommended Support Cage
Felt	0.25"–0.75" (6.4–19 mm)	Any
BHA Preveil ePTFE membrane on felt*	0.0625"–0.3125" (1.6–7.9 mm)	Any
PPS	0.25"–0.5" (6.4–12.7 mm)	Any
P84*	0.125"–0.375" (3.2–9.5 mm)	20-wire
PTFE membrane*	0.375"–0.625" (9.5–15.9 mm)	Any
Fiberglass	0.125"–0.375" (3.2–9.5 mm)	20-wire

Table 2. *Nominal recommended “pinch.”*

Thoroughly inspect cages whenever a new bag is installed. The most common problems are bent and damaged cages that cannot properly support the filter bag. In corrosive environments, cages can eventually rust and pit. Corroded areas can begin to abrade the fabric as it flexes during the cleaning cycle. Cage bottom pans with sharp edges or scalloped edges can cause similar damage.

**P84 and PTFE membranes must be sized larger for temperatures over 450°F (232°C) to account for shrinkage. P84 is a registered trademark of its respective owner.*

TABLE OF CONTENTS
ADDITIONAL TOOLS

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

Reverse-Air Collectors

To get the maximum performance in reverse-air systems, you should start by taking manometer or Magnehelic* gauge readings on each compartment at these points in the cleaning cycle:

- Before the module starts to clean
- When the module is isolated before the reverse-air damper opens
- When the reverse air is energized
- During the null period after the reverse air
- When the module is returned to service

When the module is isolated, any manometer reading other than zero indicates that the isolation damper is not sealing. Air moving through the module due to leakage can reduce the reverse air's cleaning efficiency. Also, improper tensioning of the filter bag can cause ineffective bag movement, resulting in poor cleaning and bag abrasion.

It is also very important that the null period of collection after cleaning be long enough to allow for the fine particles to fall
the length of the bag and be collected in the hopper. (This is also true for shaker collectors.)

Confirm Compartment Valves and Damper Isolation Performance

For effective off-line cleaning, the compartment being cleaned needs to be isolated from the rest of the collector. If a manometer reading indicates it's not, check for the following:

- Uneven or corroded valve seat
- Material buildup in the plenum around the valve, particularly if there's moisture in the gas stream

Consider valve and damper maintenance requirements during the initial design phase or when making changes to a system. Components that are difficult to access may not receive necessary maintenance.

Check Bag Tensioning

Proper tensioning is critical for bag performance in reverse-air or shaker baghouses. Inadequate tension can allow the fabric to overflex, reducing its strength and causing pinhole leaks along flex lines. It also allows the bag to flex and abrade against other surfaces, such as sidewalls, structural members and surrounding bags. Stress caused by overtensioned bags can cause seams to pull apart, as well as limit cleaning action in some styles of collectors.

Filter Bag Installation for Reverse-Air/ Shaker Dust Collection Systems

In baghouses using reverse-air or shaker cleaning systems, particles are collected on the inside surface of the bag. The dust-laden gas enters through the dirty side (inlet) of the collector and flows up through the bag. The particles are filtered by the dust cake and the fabric, and clean air exits through the outside of the bag.

With this design, inadequate bag tension can allow overflexing of the fabric, reducing its strength and causing pinhole leaks along flex lines. Lack of tension also allows the bags to abrade against other surfaces such as sidewalls, structural members and the surrounding bags. On the other hand, overtensioning can cause seams to pull apart, as well as limiting cleaning action in some styles of collectors.

Proper tension depends on the filter bag size. The rule of thumb is 2 lbs. to 2.5 lbs. per circumferential inch of the filter bag. Use Table 3 as a general guide. You may have to retension new filter bags after two to three months of operation to compensate for any relaxation or stretching of the fabric.

Using the right tensioning assembly can help maintain proper collection efficiency and prevent filter-to-filter abrasion (see Figure 14).

---

*Trademarks property of their respective owners.

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS
ADDITIONAL TOOLS

Bag Diameter	Tensioning Level
5"	30–40 lbs.
8"	50–65 lbs.
11.5"–12"	75–95 lbs.

Table 3. *Proper tensioning guide for reverse-air filter bags.*

On reverse-air filter bags, metal anticollapse rings of various wire gauges, materials and finishes are sewn on the outside of the bag body to prevent the bag from collapsing during cleaning. To reduce fabric wear, it is critical that the bag does not choke off during the cleaning and null cycles. The lower third of the bag requires greater support than the upper portion.

Dirty air enters through the bottom of the bag and travels upward. As a result, the bottom portion of the bag experiences high inlet grain loading, which gradually decreases as the air moves up the filter bag.

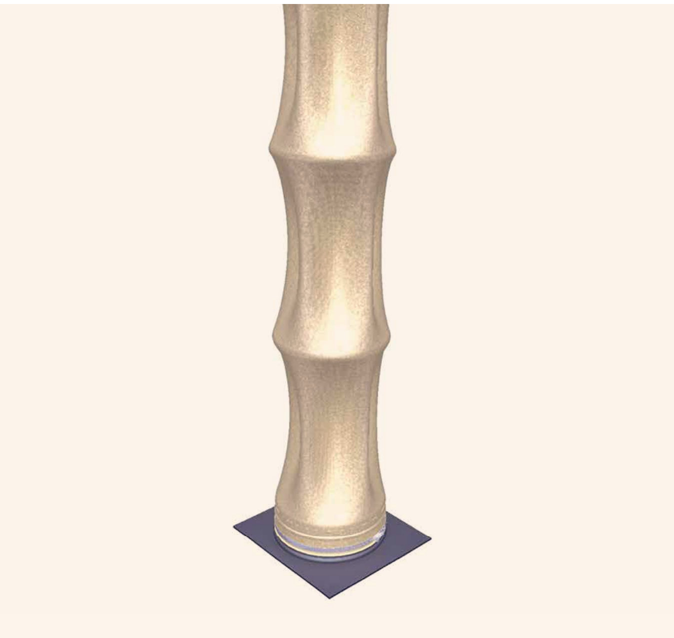


Figure 13. *Filter bag with anticollapse rings.*

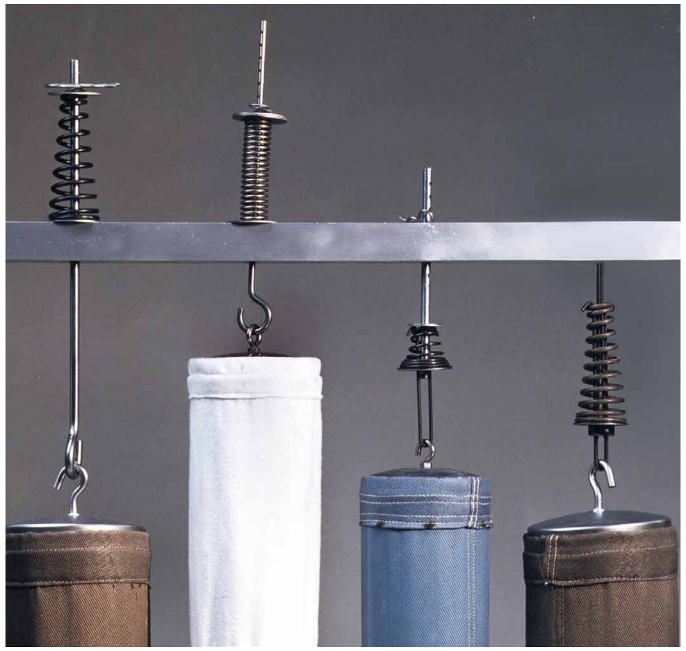
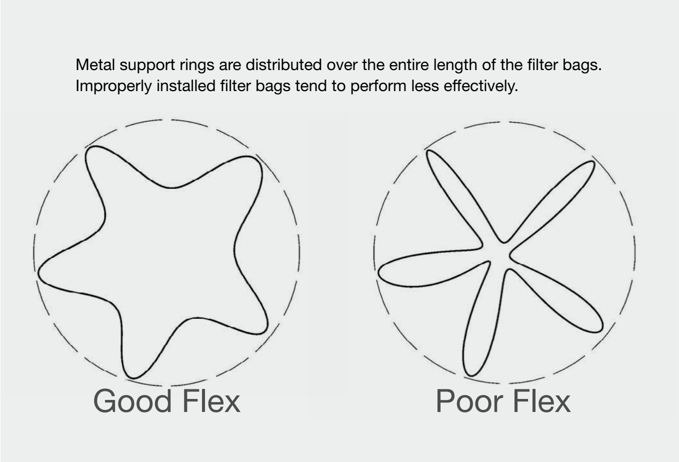


Figure 14. *Tensioning assemblies allow the fabric enough movement to clean down, yet control filter bag collapse.*

During cleaning, the reverse-air pressure drop can range from 0.5" to 1.5" WC. The lower third of the bag passes 50%–70% of the cleaning air because it is located closer to the cell plate.

Because of gravity, any slack in the bag will accumulate at the bottom. When the bag is cleaned, the inward force of the reverse air can restrict the bag at the bottom, impeding dust removal (see Figure 15). Proper tensioning of the bag can prevent this.



Metal support rings are distributed over the entire length of the filter bags. Improperly installed filter bags tend to perform less effectively.

Figure 15. *Insufficient tension allows filter bags to neck down into thimble floor, which over time may cause damage to the filters.*

The correct number of rings depends on the bag diameter and length. Use Table 4 as a general guide.

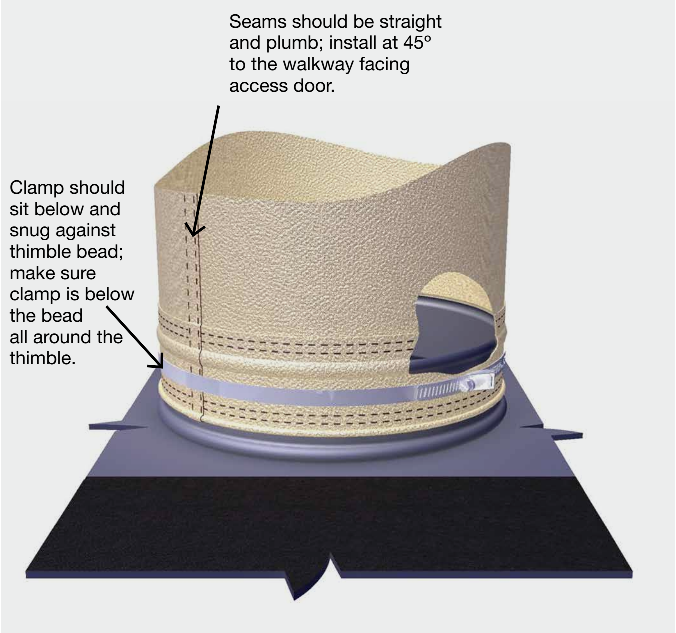
Bag Diameter	Bag Length	Number of Rings Required
5"–6"	< 120"	1 or 2 rings
	120"–130"	3 rings
	130"–168"	4 rings
	> 168"	5 rings
8"	< 260"	4 rings
	> 260"	5 rings
11.5"–12"	260"–300"	5 rings
	300"–360"	6 rings
	360"–400"	7 rings
	> 400"	8 rings

Table 4. *Determining the number of rings in reverse-air filter bags.*

NOTE: Use this information as a guideline. Unusual operating conditions or other equipment designs may require a different number of rings.

Filter bags installed in reverse-air baghouses should have their seams positioned at a 45° angle to the walkway and access door for easy verification that the seams are straight and plumb (see Figures 16 and 17). This also provides the greatest distance between bags, reducing the potential for bag-to-bag abrasion.

Figure 16. *Proper seam orientation as viewed through the access door.*


Seams should be straight and plumb; install at 45° to the walkway facing access door.

Clamp should sit below and snug against thimble bead; make sure clamp is below the bead all around the thimble.

Figure 17. *Important bag installation checkpoints.*

Secure the filter bags to the thimble first and then pull them up to the tensioning level, rather than pulling the bags down from the tensioning level to the thimble. Workers should use proper tensioning tools to ensure equal and adequate tension is applied to all bags, eliminating guesswork that can lead to bag damage during operation.

Alternately, some collectors have snapband connections at the tubesheet, which eliminates the need for thimbles. If thimbles have been a problem for a specific application it may be possible to retrofit your collector with these snapband tubesheets. Contact your Parker Hannifin | BHA representative for more information at +1.800.821.2222 or +1.816.356.8400.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

Shaker Collectors

On shaker mechanism collectors, the isolation of the module is the key to its ability to clean. (To verify the isolation and troubleshoot isolation problems, refer to Reverse-Air Collectors in the previous section.)

During a shaking cycle, the movement of the bag is designed to produce a sine wave, fracturing the dust cake so the dust falls into the hopper. Improper tensioning of the filter bag can make the movement ineffective, resulting in poor cleaning and bag abrasion.

It is the dust cake that filters the particles during operation, so you should allow a residual dust cake to form. Shaking the bags before this residual dust cake develops can lead to bleed-through and pluggage, which is commonly mistaken to be a result of inadequate cleaning. If the cleaning cycle is then activated more often to try to compensate, the problem becomes worse.

Shaker Bag Installation

Install filter bags in shaker-style collectors with the shaker mechanism moved to the maximum limit of its stroke. Then tension the filter bag so it is free of wrinkles and folds. This ensures a correct sine wave and minimum load to the shaker drive components.

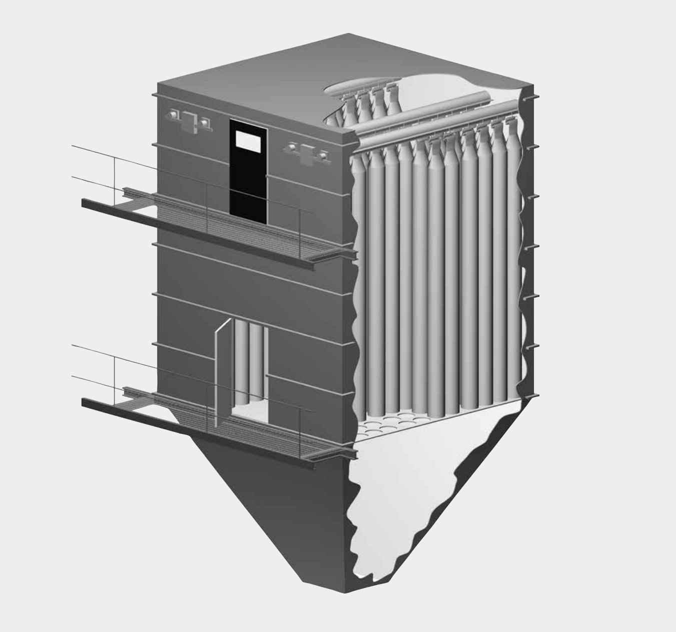


Figure 18. *Dust collector system using shaker cleaning.*

Figure 19. *These are typical top connections for shaker dust collection systems.*

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

Primary Dust Removal Equipment

A cyclone precollector can be used to reduce the amount of dust that reaches the baghouse. Spinning the airflow creates centrifugal force that moves smaller particles toward the wall of the cyclone, causing heavier particles to drop out of the air stream and exit through the bottom (see Figure 20).

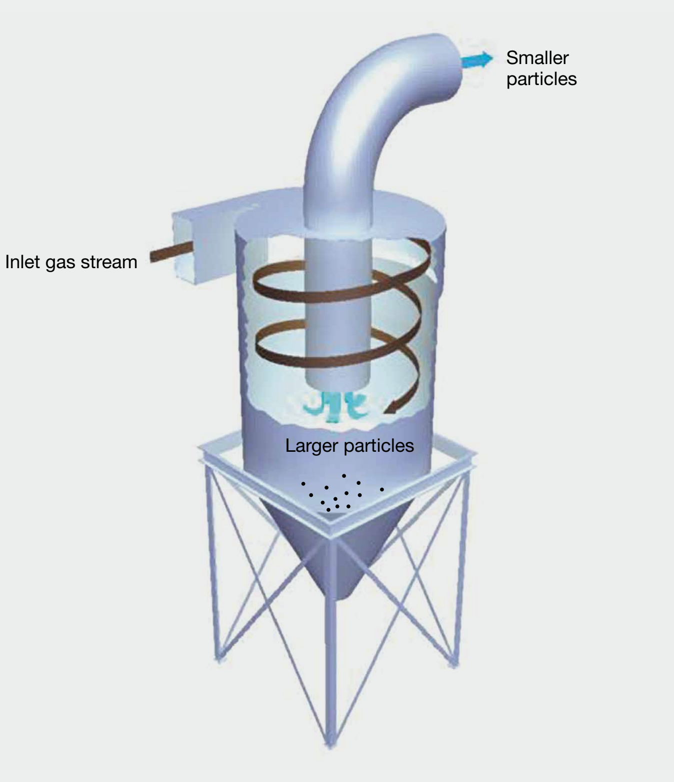


Figure 20. *A cyclone precollector.*

While precollectors can reduce the amount of dust reaching the baghouse by as much as 80%, the remaining dust is much finer because the heavier particles have been removed. This finer particulate is more likely to bleed through the fabric interstices. It also creates a denser dust cake on the collection surface of the fabric, leading to higher differential pressure.

Whenever the dust is preclassified before final filtration, it becomes more difficult to collect. If large amounts of extremely fine, submicron material are creating problems, you may need to make the precollector less efficient. This can also decrease the system's static pressure loss.

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS
ADDITIONAL TOOLS

Screw Conveyors

Systems with screw conveyors can develop problems for several reasons, but most are easily solved.

Problem: Incorrect Compartmental Cleaning Sequence

When a compartment in a baghouse with pyramid hoppers cleans, there is often enough volume to fill the lower portion of the hopper and the screw conveyor. As subsequent hoppers clean, it may be impossible to discharge the new material until the material from the first compartment is fully removed from the screw conveyor. This can cause the hoppers to overfill, which leads to bag wear, higher pressure drop and reduced gas flow.

Solution

To prevent this from happening, you should sequence the compartments to clean in the same direction as the screw conveyor flow, so the compartment farthest from the discharge cleans first (see Figure 21). In addition, the airlocks and screw conveyor must be adequately sized to handle the collector's maximum dustload.

Results

By sequencing the compartments this way, material will be removed from the first compartment first. This will allow the hopper to be clear when the first compartment recleans.

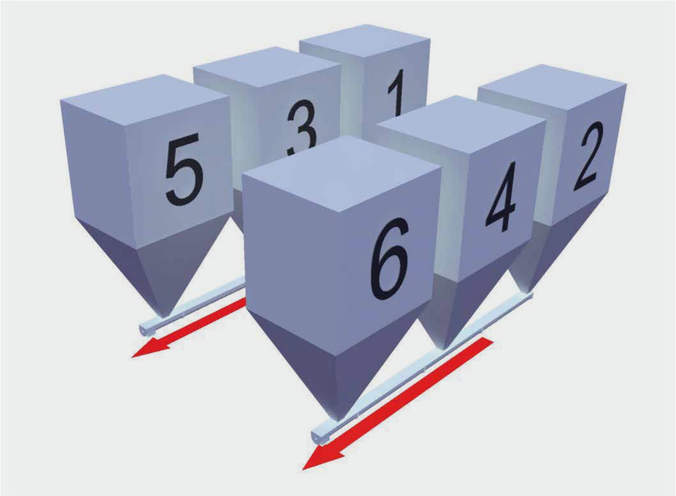


Figure 21. *Recommended compartment cleaning sequence.*

Problem: Dust Re-entrainment

On collectors with a trough-type hopper and hopper inlet that feeds a screw conveyor, dust can be recirculated by high-velocity inlet gas.

Material collected in the screw conveyor needs to be moved to a single discharge point. As the collector loads the screw conveyor, the depth of the material increases. When this mass of material is moved toward the dirty inlet (where the air velocity is highest), it often becomes airborne and is carried back to the filter bags. This increases the recirculating load in the collector and creates an artificially high pressure drop.

Solution

Reversing the screw conveyor and moving the discharge point to the end of the collector opposite the gas entrance will often eliminate this recirculation (see Figure 22).

Results

Avoiding material recirculation increases the gas flow and extends bag life. It also reduces screw conveyor wear, resulting in less maintenance.

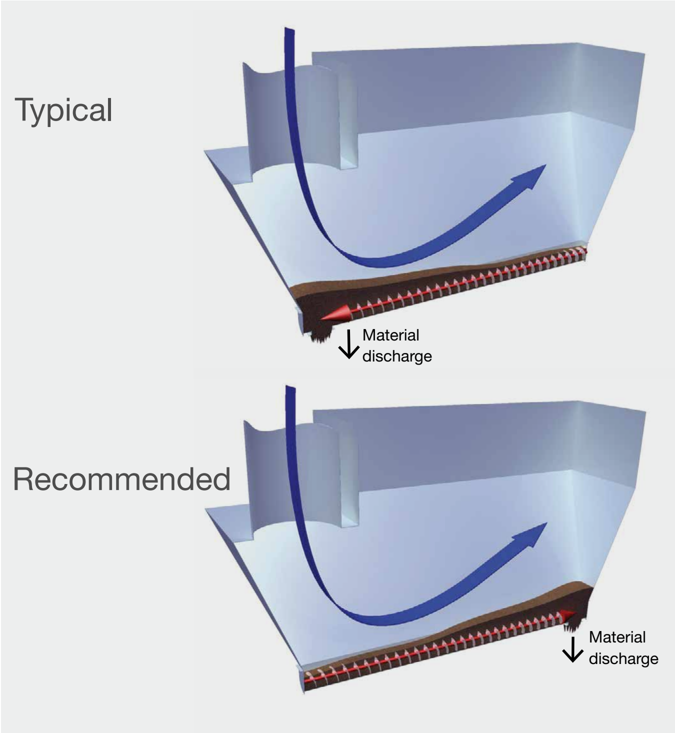


Figure 22. *Recommended screw conveyor direction.*

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

Baghouse Inlet Design

Changing your baghouse inlet design can often dramatically improve the operation of your air pollution control system.

Problem: Uneven Inlet Airflow

Many baghouses use a standard design with off-the-shelf components, often with the inlet duct collar located in the hopper. Some designs also incorporate a baffle over the inlet duct opening to direct incoming air downward into the hopper.

This airflow into the bottom of the hopper can cause collected material to swirl upward and be recirculated into the filter area, producing higher grain loading to the filter bags. If there is no baffle and the incoming material is directed straight across a narrow hopper, it can create excessive abrasion on the sidewall opposite the inlet. Poorly designed baffles can also cause abrasion holes in the filter bags.

Solution

To reduce the inlet velocity, enlarge the inlet duct prior to the hopper. Installing ladder vane baffling will even out the velocity across the entire hopper.

Results

Improving the distribution of inlet air minimizes recirculation and reduces the amount of material carried to the filter bag surfaces, creating the equipment's true can velocity. It also reduces bag abrasion (see Figure 23).

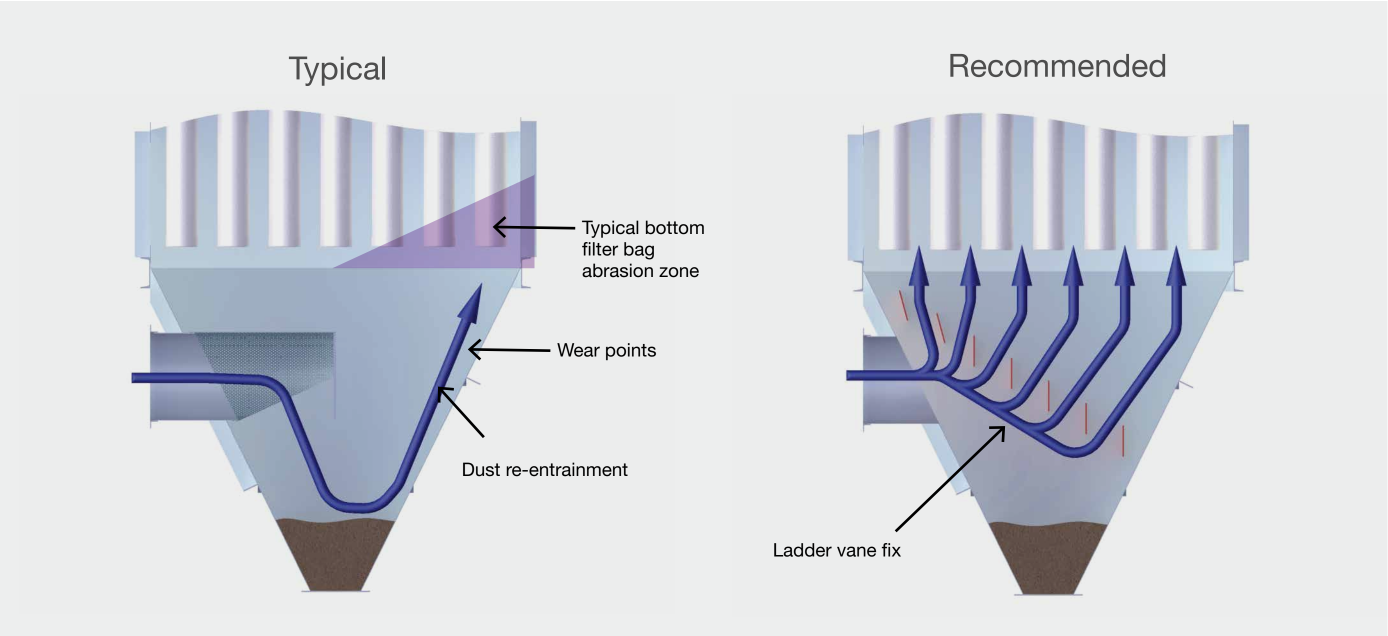


Figure 23. *Properly dispersed air reduces abrasion.*

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US
TABLE OF CONTENTS
ADDITIONAL TOOLS

Precoating System

The Importance of Building a Protective Dust Cake

For a baghouse to operate efficiently, the fabric filters must capture and release particulate during the cleaning cycle. The effectiveness of this process depends on the development of the dust cake (initial layer of dust) that protects the fabric interstices. A variety of particle sizes and shapes are needed to produce an efficient and porous dust cake. Particles that are similar shapes and sizes will form a very dense dust cake that restricts airflow.

Problem: Traditional Precoating Agents Can Cause Trouble

The right precoat agent will establish an efficient dust cake, improving filter operation and extending their life. However, many of the traditional precoat agents have serious drawbacks:

Filter Precoat Agent	Characteristics
Lime	• Alkaline by nature • Presence of sulfur can form gypsum, leading to plugging or blinding of filter bag • Similar particle sizes create dense, compact dust cake
Fly Ash	• Generally abrasive • pH varies from highly acidic to very basic • May require pretreatment to alter hazardous material makeup • Material is heavy and often falls off bag
Diatomaceous Earth	• Typically used for wet filtration applications • Introduces moisture and hydrocarbons into the gas stream • Moisture binds the diatomaceous earth to the filter surface, causing permanent blinding and loss of airflow

Table 5. *Traditional filter precoat agents.*

Solution
BHA Neutralite® Conditioning Agent

BHA Neutralite powder avoids the problems associated with many traditional precoat agents, protecting bags from particulate bleedthrough, blinding and problems caused by hydrocarbons and moisture carryover.

- Light-density aluminum silicate powder
- Varied particle size to prevent blinding of filters
- Works in a wide range of applications
- Proven to help lower differential pressure, increase airflow and lower emissions
- Absorbs hydrocarbons, moisture and sparks (BHA Neutralite SR (Spark Retardant))
- No detectable free silica content

Contact your Parker Hannifin | BHA representative for more information at +1.800.821.2222 or +1.816.356.8400.

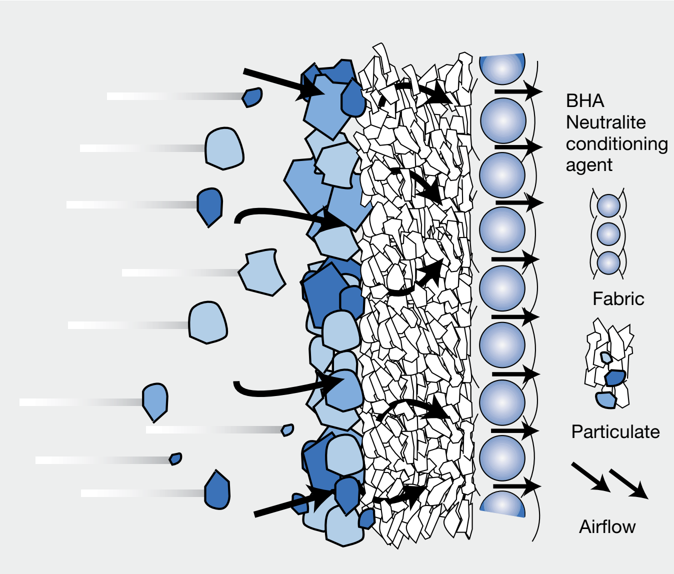


Figure 24. *By injecting an initial dust cake of conditioning agent, the fabric is protected from particulate, while still allowing airflow to pass through the dust cake.*

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

BHA Leak Detection System

A leak detection system can help reduce downtime and is more effective and safer than visual inspections. Such systems typically use a powder whose particle size and distribution are designed to provide the highest visibility for locating filter bag tears, holes and bad seals, as well as structural weak points such as weld cracks.

For example, the BHA Visolite leak detection system uses a lightweight fluorescent powder that is injected into the baghouse. The powder follows the path of least resistance, accumulating around the source of leakage, whether it is a weak area in the filter media or a bad seal. A monochromatic light is then used to pinpoint the exact location of air leakage and indicate its severity. See Figure 25.

Three Colors for a Variety of Industries

BHA Visolite powder is available in three different colors and has a broad particle size distribution to minimize fabric bleedthrough. Straight pigment is also available for specific applications. Choose the best color for your application:

- Pink—all industries
- Orange—all industries except those where iron oxide is present
- Green—aluminum, cement and utility industries; good contrasting color for pink and orange

Monochromatic Lights to Use with Visolite Powder

We offer a variety of monochromatic lights to use with BHA Visolite leak detection powder. The Viso Big Light has a special high-intensity beam for brightly lit areas. Portable cordless lights are a convenient, lightweight solution, ideal for small areas.

Figure 25. *The BHA Visolite leak detection system includes a choice of fluorescent powders and monochromatic lights for various applications.*

GENERAL TROUBLESHOOTING

Additional Tools

BHA Preveil Laminated Filter Bags

Baghouse Accessories Brochure

Glossary of Dust Collection Terms

Maintenance Checklist

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

CEMENT INDUSTRY

This section presents troubleshooting measures and operational guidelines specific to the Cement Industry. These ideas are intended to supplement the information outlined in the General Troubleshooting section.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

ENGINEERING YOUR SUCCESS.

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS
ADDITIONAL TOOLS

Kiln/Raw Mill Baghouses

There are several generations of raw mill kiln baghouse circuits. Many of the early generations consist of only the raw mill, baghouse (usually reverse-air) and some type of temperature control device.

The operating conditions for the mill-off and mill-on modes are very different:

- **Mill-off mode**—Temperatures higher, grain loading much lower, dust has little moisture
- **Mill-on mode**—Temperatures lower, grain loading much higher, dust has more moisture

It is virtually impossible for a baghouse to adjust to these two very different operating conditions and maintain differential pressure and low emission levels.

OLDER SYSTEMS

Problem: Temperature Fluctuations Increase Emissions

When the raw mill is down, higher temperatures increase the air volume, thereby raising the differential pressure. The lighter grain loading and dryer dust make it difficult to build and maintain a dust cake, usually increasing emissions to higher than desirable levels.

Solution

Switching the filter bags from woven fiberglass to woven fiberglass laminated with BHA Preveil ePTFE membrane addresses the emission issue, but doesn't solve the higher differential pressure caused by the higher mill-off baghouse temperatures. Unless a better temperature control device is installed, it may be unavoidable to have a higher differential pressure when the mill is off.

In this case, if filter bag cleaning is based on differential pressure, Parker Hannifin recommends using higher set points during mill-off conditions to avoid overcleaning the filter bags. Remember—the higher differential pressure is being caused by higher airflows, not dust.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

NEWER SYSTEMS

Newer-generation circuits have better temperature control, so mill-on and mill-off temperatures are the same and so is the air volume. Cyclones between the raw mill and the baghouse can greatly reduce the grain loading when the mill is operating.

Problem: Smaller Dust Particles

Although the newer circuits stabilize the operating conditions, they create new challenges. Most of the new systems are equipped with pulse-jet baghouses, but now there are smaller dust particles entering the baghouse and operating temperatures very near the acid dew point.

Solution

Many new baghouses come equipped with various weights of woven fiberglass filter bags laminated with ePTFE membrane. Based on experience, Parker Hannifin typically recommends the 22 oz./yd.^{2} weight.

The filter bags should be cleaned on-line, based on total baghouse differential pressure. When cleaning is initiated, at least one row per compartment should clean at the same time to ensure the baghouse is cleaned evenly from front to back. Also, dust is metered out of each compartment, which avoids introducing too much dust to any one compartment hopper. This method also cleans the filter bags less, extending their life, while maintaining the same differential pressure as other cleaning methods.

Reverse-air baghouses also operate better with a proper cleaning cycle. All have two banks of compartments with a center inlet plenum. The compartments should be cleaned in the direction of the screw conveyors under the hoppers, going from side to side (see Figure 21 on page 17).

The cleaning should again be controlled by the total baghouse differential pressure. Only clean the number of compartments necessary to drop the total pressure ½" to 1". When the higher set point is reached again, the cleaning should resume where it left off in the sequence.

The startup procedure is very important to minimize corrosion. When starting up the kiln, only have the back one or two compartments on-line and the cleaning system off. When the inlet temperature reaches 300°F (149°C) or the total baghouse pressure reaches 6" (150 mm), bring the next compartment on-line. Continue this procedure, going from side to side, until all compartments are on-line, and only then turn on the cleaning system.

When shutting the baghouse down, manually clean the filter bags for two complete cycles.

TABLE OF CONTENTS
ADDITIONAL TOOLS

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

Truck and Rail Loading Spouts

Problem: Loading Emissions

Emissions from the spout during loading of truck bulk tanks and railcars is a prevalent, but often overlooked, problem. Emphasis by air regulatory agencies and complaints from bulk truck operators have caused many companies to make cleaning up this system a priority. A poorly designed system can limit loading rates.

Causes

- **Spout**—Most loading spouts are designed to discharge the product at the same level as the ventilation plenum that surrounds the discharge spout. That causes excessive product to be drawn into the ventilation air stream.

  The excessive amount of material drawn into the ventilation system reduces the dust collector airflow. This reduced airflow volume is much lower than the ventilation design volume, so it's unable to keep the vented material airborne inside the vent plenum. When that happens it may plug some or all of the plenum circumference. An indicator of this problem is product falling out of the spout while lifting it after loading is complete (see Figure 27).
- **Fan**—In most cases the baghouse and baghouse fan are undersized.
- **Ductwork**—In many cases the ductwork is not sized to the fan volume, creating high velocity and duct wear or causing material fallout.
- **Baghouse**—Dust collector designs may not be properly sized to the fan volume and/or not equipped with the proper filter media to resist moisture agglomeration.

Solution

To eliminate loading spot emissions Parker Hannifin recommends addressing the four parts of the system that can cause it: the spout, the fan, the duct system and the dust collector. Many current loading spout systems can be upgraded to the recommended design features without large capital expenditures.

Spout Modifications

Two spout modifications may be appropriate to correct this problem:

1. Lower the product discharge point below the level of the ventilation plenum opening by adding about 6" (152 mm)
   to the discharge spout so it is inside the tank lid.
2. Raise the vent plenum opening off the tank lid to maintain the design airflow volume by eliminating the restriction of the seal that the spout creates with the tank lid. This is accomplished by adding four gusset plates around the perimeter of the spout to raise the level of the vent plenum about 2" (51 mm) above the tank lid.

Fan Sizing

The following formula is recommended by a major manufacturer of loading spouts to calculate the required air volume for the ventilation system. When sizing the fan, assume a 5" (127 mm) WC static pressure loss through the spout portion of the ventilation system.

$$\text{Ventilation Air Volume} = \frac{\text{Tons/Hour Unloaded x 33.3}}{\text{Aerated Bulk Density (in lbs./ft.}^3\text{)}} \text{x 3.25}$$

Don't forget to factor in all additional air contributed to the system by air slides and air pads on the silo. The 33.3 factor in the formula converts tons per hour to pounds per minute, and the 3.25 is a safety factor based on experience. The aerated bulk density is often much lower than the normal bulk density of the material (e.g., 40 lbs./$ft.^2$ for cement).

Duct Design

The duct must be designed with a diameter that produces the proper conveying velocity within the duct to keep the material airborne. This velocity is 3,500 FPM for cement. The duct slope should be a minimum of 50° wherever possible, and horizontal runs should be avoided to help prevent dust buildup within the duct. The duct must also be designed with proper elbows and transitions if other ducts are merged with it.

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS
ADDITIONAL TOOLS

Baghouse Design

Parker Hannifin recommends a pulse-jet design for the dust collector because they are more compact than other types, which is useful since loading areas usually have limited space for a dust collector.

We also recommend filters laminated with a PTFE membrane. Using pleated, spun-bonded polyester filter elements allows the pulse-jet dust collector to be smaller than when using cylindrical bags. These filters also provide very high filtration efficiency, increased airflow and a slick surface finish to prevent moisture from triggering agglomeration of the material.
The air-to-cloth ratio and interstitial velocity between the filters are the main criteria to consider in the design. These factors are dependent upon the material being vented and the type of filters used.

The pulse-jet cleaning system should use a pulse-on-demand mode that maintains a desired differential pressure across the filters. This will prevent overcleaning of the filters and avoid wasting compressed air when cleaning is not needed.

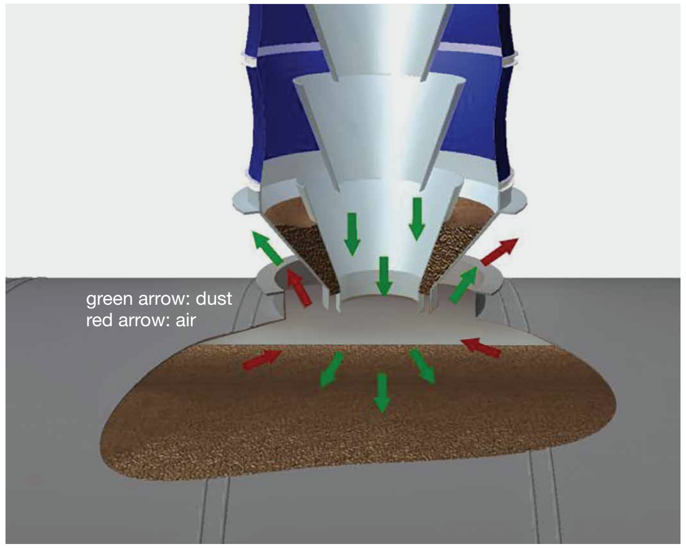


Figure 27. *Typical truck loading spout.*

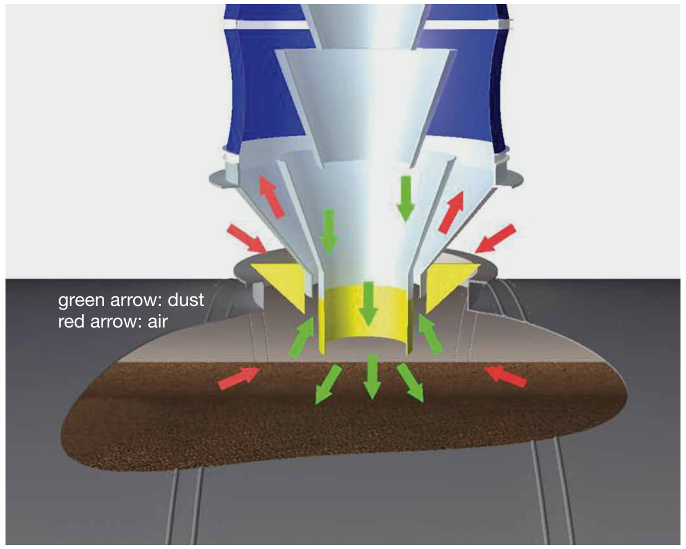


Figure 28. *Recommended truck loading spout.*

Point Venting for Air Conveyors

Problem: Air Conveyor Leaks

Air conveyor emissions are a common problem. Due to the high air pressure created during air conveyor operation, leaks often occur at weak spots in welds, bolted connections and poorly aligned surfaces. These nuisance emissions are costly in maintenance time and expense and may reduce the effectiveness of the equipment. In addition, all leaks cause loss of product, since most air conveyors are used for finished product transfer.

Solution

Air conveyor vent collectors (ACVC) can effectively reduce equipment emissions. They install directly on top of the existing conveyor housing.

ACVCs use pleated filters such as BHA PulsePleat filters, which combine improved airflow and fine particulate capture with extended service life. Unlike traditional felt or woven fabrics, the BHA PulsePleat filter material's tight pore structure resists particulate penetration, making it ideal for this high-pressure application.

Pleated media can increase filtration surface area two to three times compared to conventional filter bags, dramatically increasing filtration efficiency while operating at significantly lower differential pressures. The material can be pulse cleaned from the filter and redistributed to the air conveyor, reducing product loss.

Benefits of Point Venting:
- No material handling
- Simple installation
- No fan required in most applications
- No ductwork necessary
- Low maintenance
- Only 110/220 V power required

Figure 29. *Air conveyor vent collector.*

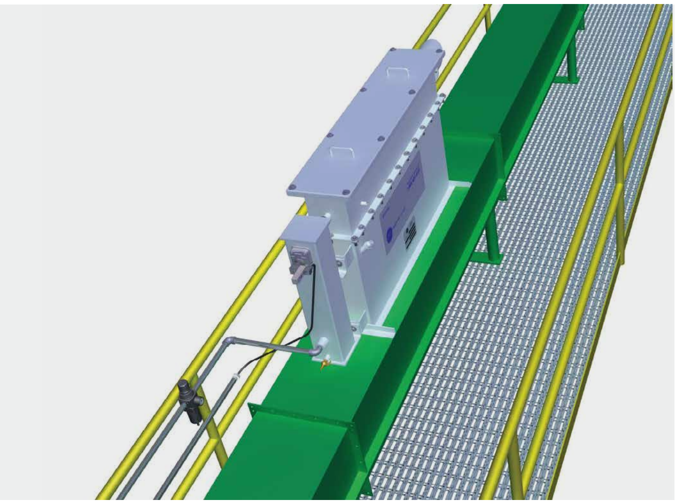


Figure 30. *Air conveyor vent collector mounted on air slide.*

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS
ADDITIONAL TOOLS

Point Venting for Conveyor Belts

Problem: Multiple Venting Points, Requiring Complex Ductwork

Conveyor belt venting is a challenge at cement plants, because each location where material is transferred onto a belt conveyor must be properly vented, and a typical cement plant has numerous transfer points.

The traditional solution is to vent the transfer points with enclosure hoods that are linked to a dust collector by ductwork. Proper duct routing is difficult to achieve, however, because of the confined space and the need to route the ducts around structural members. So there are often numerous elbows, which translates into more wear on the system (along with more maintenance and patching) and a higher static pressure loss (requiring more horsepower to operate the dust collector fan). In addition, multiple vent point dust collector systems are difficult to balance, often leaving vent points overvented or undervented.

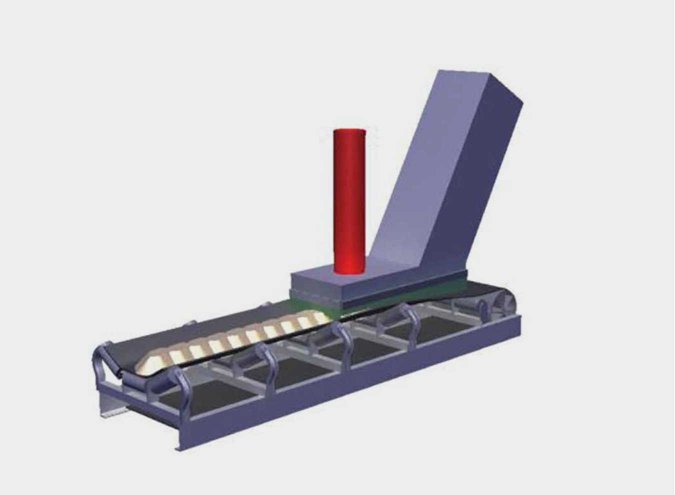


Figure 31. *The traditional approach to belt conveyor venting.*

Solution

Point venting provides a cement plant with a best-value solution for improving the belt conveyor venting system and eliminating problems. The point venting method requires no ductwork, hoppers, airlocks or feeders, since the dust is collected at each source and returned to that same source.

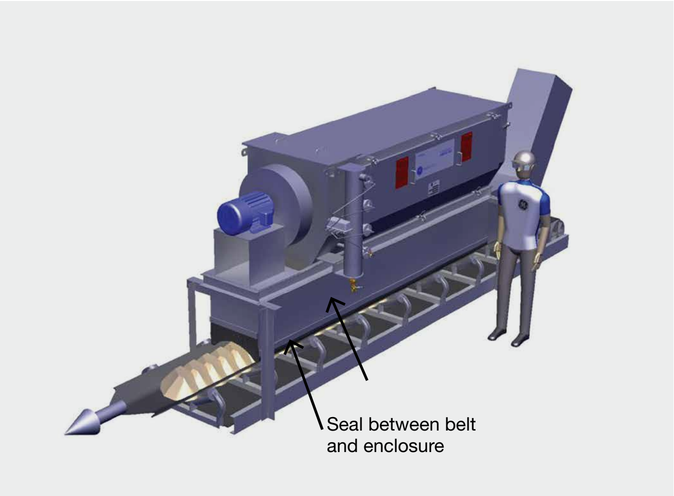


Figure 32. *Point venting a belt conveyor with a horizontal collector.*

Parker Hannifin's point venting technology uses a horizontal collector, named for the manner in which the filters are mounted. The advantage of horizontal collectors over other point venting systems is that they're designed and constructed for heavy-duty use, with filters that can be easily and efficiently cleaned—important when a dust collector with a large filter area is operating in a confined space.

Figure 33. *Horizontal collector with easily replaceable pleated filter elements.*

As shown in Figure 33, the collector frame is mounted to the top of the enclosure housing on the conveyor belt. A direct-drive fan is mounted to the steel channel support frame of the vent unit and connected to the end of the clean air plenum.

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS
ADDITIONAL TOOLS

Venting Vertical Mills Used for Grinding Cement and Coal

Problem: Heavy Dust Loads

Vertical mills produce grain loading greater than 285 gr/scf (650 g/Nm^3) to the dust collectors venting them, leading to high differential pressure and reduced production.

Solution

To avoid the problems such a heavy grain load can cause, consider these factors:

- The dust collector should be designed with an air-to-cloth ratio less than 4:1 (1.22 m^3/min./m^2).
- The can velocity should be less than 275 FPM (1.4 m/s).
- The dust collector's filter bags should be cleaned based on differential pressure. An automatic clean-on-demand system with a pressure switch can begin the cleaning cycle when the high differential pressure set point is reached and stop it after it cleans down to the low set point. Maintaining a consistent differential pressure (and therefore, consistent airflow) is critical to good mill performance.

For finish grinding and coal grinding mills, you may need to consider additional factors.

Finish Grinding

Vertical finish mills present several challenges for dust collectors:

- Small dust particles
- Heavy grain loading
- High moisture

Traditionally, polyester felt has been the workhorse in dust collectors venting ball mills, but these extreme conditions require a more advanced solution. We recommend either acrylic or aramid felt laminated with BHA Preveil ePTFE membrane for good airflow and efficiency. ePTFE membrane filter bags can handle the high grain loading and small particles without allowing dust to penetrate the membrane. This allows the filter bags to have a higher airflow and lower pressure loss. The slick surface of the filter bags facilitates better clean-down, even in high-moisture conditions. However, the critical design and operating conditions will still need to be met for good performance.

Coal Grinding

Vertical coal mills have the same challenges as vertical finish mills, with the addition of potentially explosive dust.

Because of the heavy grain loading to the baghouse, design is critical. Dust cannot be allowed to build up in any area. The hopper evacuation system must be designed to eliminate material buildup; the baghouse, filter bags and cages must be grounded; and the baghouse must be equipped with explosion vents in the form of membrane rupture valves.

In most cases the moisture content is higher than with finish mills, making it even more important to use filter bags laminated with membrane like BHA Preveil ePTFE membrane. As with finish mills, the fabric should be acrylic or aramid felt. When grinding materials other than coal, such as petcoke, you should review the operating data to determine if membrane filter bags are appropriate.

The operating temperatures for coal mill baghouses are usually in the range of the acid dew point. Because of this factor and the presence of sulfur, baghouses constructed with mild steel have not fared well. Therefore, we recommend stainless steel, at least for the clean air plenum. 316L stainless steel has performed very well in this application.

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS
ADDITIONAL TOOLS

Ball Mill Sweep Baghouses

Problem:
Heavy Dust Loads Decrease Efficiency

Many finish grinding ball mills have a sweep design that positions the vent close to the material discharge area. The discharge is vented in order to maintain gas flow through the mill and cool the product.

When the discharge hood is positioned over the discharge, it can pull material into the baghouse, creating excessive dust loading. That results in a high differential pressure and duct wear that can reduce the air volume that vents the mill.

Solution

Enlarging the mill discharge section of the sweep duct and extending it as high above the mill as possible to reduce the velocity to less than 1,000 FPM (5 m/sec.) converts this takeoff duct into a dropout chamber with no additional pressure drop. This effective modification allows coarse material to fall into the material loop, decreasing the grain load to the baghouse. That reduces the pressure drop and results in increased air volume and lower temperatures in the ball mill. In many cases, the material collected in the baghouse is finished product that can be transported to the silos, reducing the recirculated load.

Changing the sweep duct can have a dramatic impact on the overall system, since the baghouse is now collecting finished product instead of serving as a material handling system. In many cases this will increase mill production.

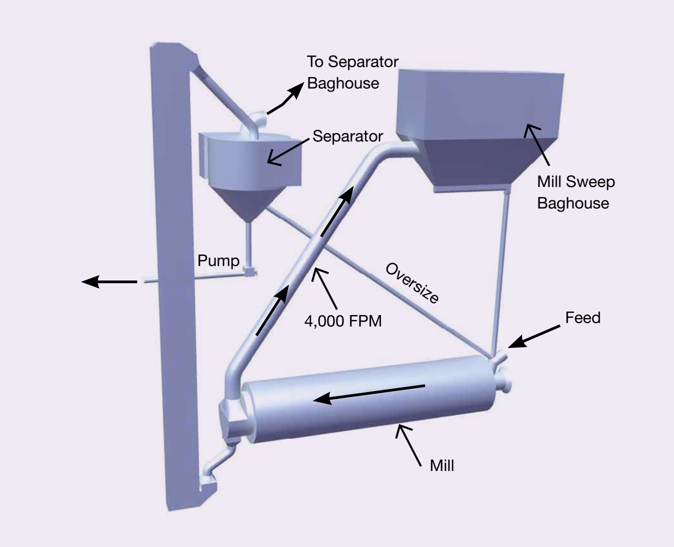


Figure 34. *Typical mill sweep arrangement.*

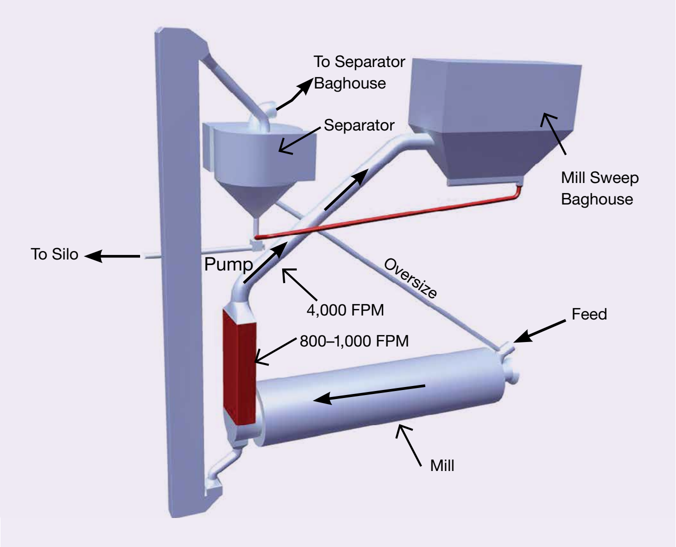


Figure 35. *Recommended mill sweep modification.*

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US
TABLE OF CONTENTS
ADDITIONAL TOOLS

Clinker Cooler Dust Collectors

Problem: Older Filter Types and Poor System Design Can Limit Productivity

Even relatively new clinker cooler dust collectors may not be delivering the efficiency that can be achieved with the latest filter element technologies. This can be especially true for older designs where the bottom portion of the filter bags is directly in line with the gas stream, making them vulnerable to the highly abrasive clinker dust.

Solution

BHA PulsePleat filters can replace traditional filter bags and cages in pulse-jet-style dust collectors. The pleated design provides two or three times more filtration area than standard filters, so it's like expanding the size of the collector without any structural modifications. This increased filtration area reduces the differential pressure across the filters, which can mean lower operating costs and increased productivity. BHA ThermoPleat® pleated air filters provide these same advantages for dust collection systems that operate at high temperatures.

Pleated filters from Parker Hannifin combine high-efficiency filtration media with an inner support core in a one-piece element. We have designed and manufactured pleated filters for a range of applications, incorporating a variety of media from polyester to aramid and PPS felts.

Over time, clinker cooler systems have improved a lot. Systems built in the past 10 to 20 years have heat exchangers between the clinker cooler and the dust collector. The heat exchanger greatly reduces temperature spikes and also reduces the dust loading to the dust collector. In some cases, plants have been able to install polyester filters, because dust collector inlet temperatures are so low. These systems can usually be brought up to the new standards with only minor tweaking.

However, some plants are operating the dust collector at a higher air volume than it was designed for, or the original design is less than desirable. In these cases, pleated elements along with attention to ductwork velocities can bring great improvements.

Pleated elements can also improve the performance of older collector designs where the bottom portion of the filter bags is exposed directly to the gas stream, making them vulnerable to the highly abrasive clinker dust. Changing the duct design while paying attention to the velocity can help, along with installing pleated filters, which will improve the operation of the dust collector and, in most cases, reduce the dust load the elements see. In addition, pleated filters are significantly shorter than filter bags while having more than twice the cloth filtering area.

Figure 36. *High-temperature BHA PulsePleat filters, called BHA ThermoPleat elements, provide a simple retrofit for upgrading existing dust collection systems and improving problem systems.*

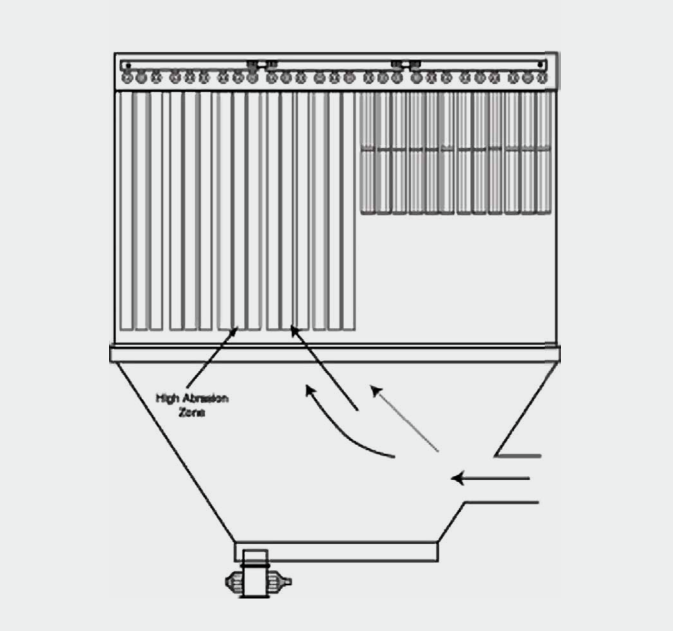


Figure 37. *The shorter length of pleated filter elements helps reduce abrasion problems.*

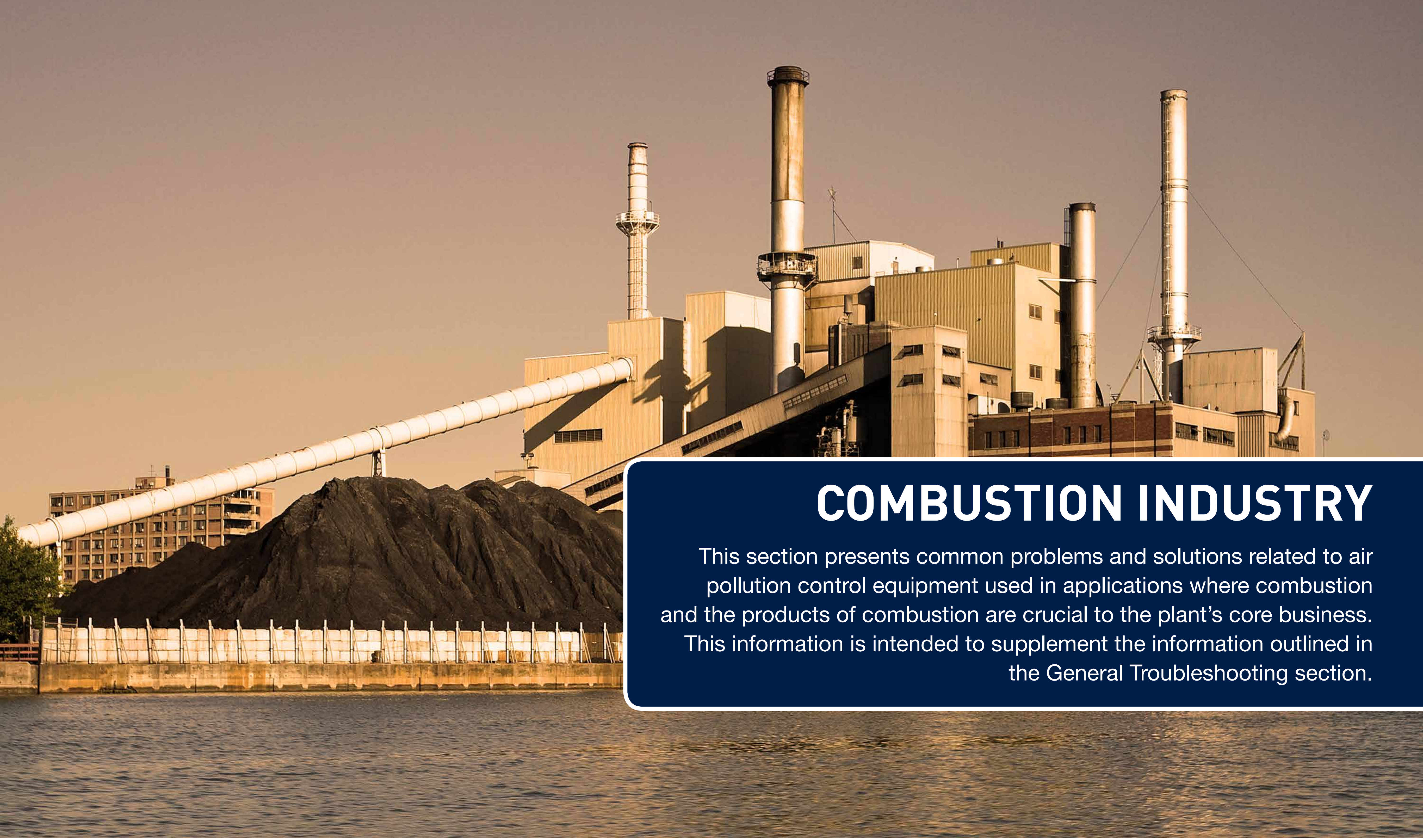
CEMENT INDUSTRY

Additional Tools

Clinker Cooler Baghouse Case Study

Parker Hannifin offers improvements and solutions for every dust collector in your operation. Check out this article “The Sum of Its Parts”, Part 1 and Part 2 found on the World Cement website.

Part 1 **Part 2**



COMBUSTION INDUSTRY

This section presents common problems and solutions related to air pollution control equipment used in applications where combustion and the products of combustion are crucial to the plant's core business. This information is intended to supplement the information outlined in the General Troubleshooting section.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

ENGINEERING YOUR SUCCESS.

TABLE OF CONTENTS
ADDITIONAL TOOLS
GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

Combustion Processes

Each combustor has its own design traits, system design differences, fuel characteristics and operational variables, which all create application- and site-specific conditions. For example, while pulverized coal (PC) boilers are an optimum design for utilities that have fluctuating demands, fluidized bed combustors (FBC) perform better for independent power producers who burn a variety of fuels.

Different combustion system designs create different types of fly ash. The chemical composition of the fuel, type of combustor, combustion temperature, mechanical collection, flue gas conditioning and baghouse design and operation all affect fly ash filtration performance.

For example, stoker boilers tend to create large particulate and are prone to unburned hydrocarbons, while PC boilers are known for fine particulate, partially due to their efficient high-temperature burn. Fluidized bed combustors are known for their ability to burn low-grade fuels, which produces large amounts of ash (see Figure 38).

Gas stream components above their dew point are not particularly harmful to baghouse operation. But when the temperature suddenly decreases or the moisture level rises above the dew point, the resulting reaction can cause corrosion and heavy buildup on the filters, which can be difficult to remove.

Figure 38. *Factors influencing dust cake characteristics.*

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS
ADDITIONAL TOOLS

Operating Variables

A number of process factors can impact baghouse performance.

Acidic Conditions

A common problem with baghouses on boilers is the risk of "acid attacks" as a result of flue gas temperature excursions through the dew point, combustion product variables and upstream equipment malfunctions. This can corrode carbon steel components, cause chemical damage and filter media blinding, create problems with hopper evacuation and make the stack plume visible.

Off-peak load conditions and cyclic boiler systems can increase the occurrence of acid gas, so operations should incorporate well-designed startup and shutdown procedures to minimize these conditions. For cyclic operations, it's best to have two cleaning systems—an automatic one for high or peak loads and a second manual system for low loads.

Because of these variable boiler operating conditions, you may need to consider different filter media and/or protective finishes. Before making any changes, however, you should measure and compare the actual system operating values against the design conditions.

Newer advanced dry filtration technologies can improve efficiency and operation while lowering costs. Pleated filter element technology provides two to three times more filtering area than other types, while high-efficiency filter media allow increased airflows. Microporous BHA Preveil ePTFE membranes laminated to traditional textiles provide very high efficiencies along with a slick, nonstick surface to reduce the risk of system upset conditions. These advanced filter technologies can also reduce baghouse system energy costs.

Baghouse Overloading

Numerous conditions can create an overload situation:

- Peak load boilers can become overloaded, causing the baghouse to exceed its design parameters. This condition can negatively affect filtration efficiency and resistance across the filters, which disrupts the process airflow and draft. Baghouse operation must be flexible enough to accommodate these fluctuations.
- Switching to fuels with lower BTU values generates additional ash and, therefore, more grain loading to the baghouse.
- Upstream equipment for multiple-pollutant control can also increase baghouse grain loading, such as the addition of powder-activated carbon (PAC) for mercury control, selective catalytic or noncatalytic reduction (SCR/SNCR) slips and catalyst erosion.

Blinding or Bleed-Through of Filter Media

In addition to heavy grain loading reducing filtration efficiency, other factors can cause blinding of traditional woven or needle-felt filter media. Changing fuels can result in finer ash particulate size, leading to filter bleed-through or blinding. When one of these conditions happens the baghouse has to work harder, as resistance across the filters increases, airflow diminishes and cleaning frequency goes up.

Another variable that can affect baghouse operation is the use of a mechanical drop-out system before the baghouse. Precollectors such as cyclones, multiclones, dropout boxes and de-energized electrostatic precipitator systems can reduce the load to the baghouse, but they also decrease the particle size range of the ash. These finer ash particles produce a denser, less permeable dust cake. That in turn increases airflow resistance, forcing the fine ash into the filter media and causing bleed-through emissions or plugging the fabric internally.

These conditions may require changes to the cleaning system. A precoat material may also be needed to promote an artificial dust cake, especially during startup with new filter bags. Precoating can provide a barrier to these fines, protecting the media from blinding.

Fuel and Flue Gas Neutralization

Due to environmental regulations and the types of fuels being burned, many systems are being constructed with an acid gas scrubbing system before the baghouse. These dry or semi-dry scrubbers chemically convert the acid gas to a solid particulate.

A component slurry of lime sodium bicarbonate or magnesium oxide is atomized by either dual fluid nozzles or rotary atomizers and injected into the scrubbing tower. The dust that exits the reaction chamber has a high amount of moisture and is very dense because of its high reagent content.

This type of dust cake can become extremely dense and difficult to remove with conventional cleaning methods. It is a good practice to review the cleaning cycle to ensure that cleaning energy is maximized. For systems that can clean off-line such as reverse-air baghouses or pulse-jet collectors, horns such as BHA Powerwave® cleaning systems can be used to generate acoustic energy that intensifies the cleaning process without damaging the filter bags.

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS
ADDITIONAL TOOLS

In some instances, the towers themselves can experience buildup problems on both the nozzles and the sidewalls. Buildup on the nozzles can lead to poor atomization of the slurry, encouraging moisture carryover to the baghouse. Buildup on the sidewall can lead to increased differential pressure across the unit, compromising draft at the process. Cleaning the inside of the vessel during outages typically requires extensive time and expense.

Acoustic horns also achieve good cleaning results when mounted on the sidewalls of the scrubber (see Figure 39). Their low-frequency sound energy resonates in the tower, helping to remove buildup on the walls and keep the outlets from becoming obstructed.

Because of the different fuels used in the combustion process, there may be a variety of problems with material and gas carryover to the baghouse. Contact your Parker Hannifin | BHA representative for more information on how various fuels and processes can affect your baghouse's operation and how to solve any problems you encounter.

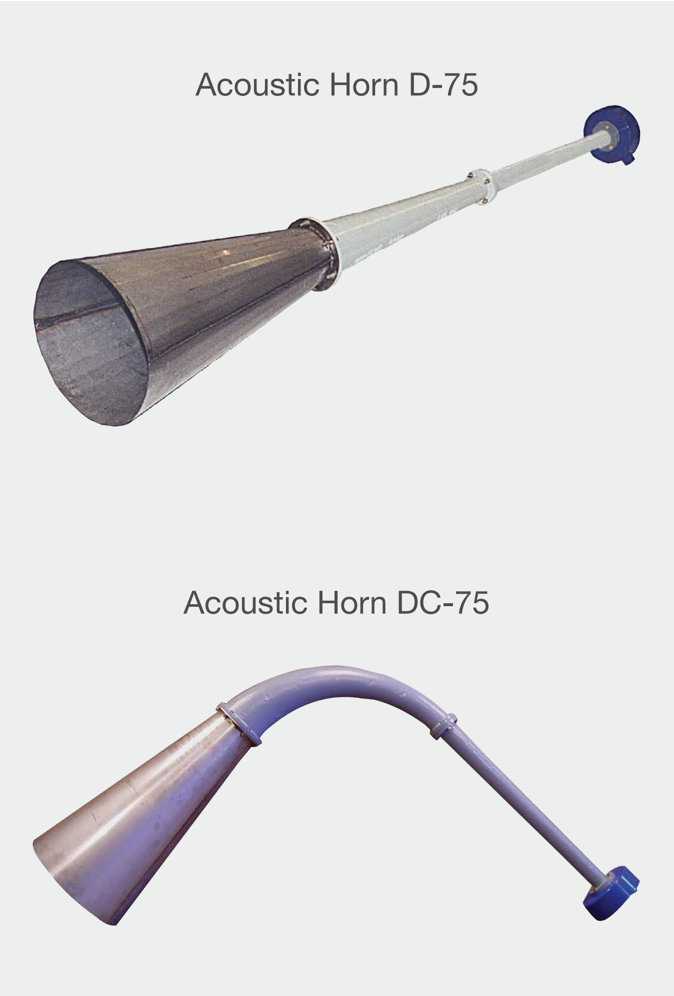


Figure 39. *The sound waves generated by acoustic horns create vibrations that effectively break apart and dislodge material deposits from surfaces.*

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

Startup and Shutdown for Combustion Processes

Air ventilation systems filtering hot flue gases that operate on an intermittent basis are subjected to frequent excursions below the dew points of water and acids. Many times a plant is started up and the outlet stack temperature is monitored to ensure a high gas temperature is present, without regard to the temperature of the steel components within the collector.

Two problems occur from this procedure: first, the rapid increase in temperature causes mechanical stress to steel components; second, condensation forms when the steel temperature is not above dew point.

In applications where water vapor is added to the gas stream by a scrubber or gas cooler, the gas stream temperature drops initially. The lower-temperature, moisture-laden gas then enters the improperly heated collector and the water vapor condenses, causing corrosion and filter damage.

When SO_X gases are present and there are excursions below the acid dew point, sulfate salts are formed. The salts react with the metallic oxides to form metallic salts, which in some cases are very corrosive. Sulfate salts attach to the filter fabric in the form of agglomerations that decrease the available filtration area, inhibiting airflow. This can also contribute to material-handling problems.

The moisture can combine with products of combustion, such as sulfur oxides, creating a low-grade acid in the collector. This acid can reduce the strength of the filter fibers, leading to filter bag failure and corrosion of metal surfaces.

Startup Procedure

The baghouse should be preheated to a temperature above the acid dew point before the process is started. (Dew point temperature varies according to the chemicals and oxygen present in the gas stream, relative humidity of the air, etc.) The objective is to minimize the potential condensation period inside the unit. This is accomplished by moving the collector through this corrosive temperature gradient as quickly as possible (see Figure 40). Startup should be performed without moisture-laden gases being introduced into the collector.

Shutdown Procedure

It is important to remember that when the process is shut down, the baghouse temperature will be reduced, causing the gases to go through dew point. This will result in condensation in the baghouse system.

During shutdown on corrosive gas processes, the dirty gases should be purged immediately by pulling clean gases (if available) through the unit. This avoids trapping the corrosive gases in the baghouse as it cools down through the acid dew point. Purging removes corrosive gases and rapidly cools the baghouse through the dew point zone, minimizing the damage caused by condensation and corrosive salts formed in the shutdown procedure. Depending on the severity of the conditions, a neutral desiccant material can be placed on the filters to add a protective barrier against degradation.

Fabric selection is an important consideration in dealing with dew point excursions. Woven fiberglass fabrics should be protected with a chemically-resistant finish. Finishes that can protect from both acid and alkali attack and increase the flex endurance of the fabric are available. High-temperature synthetic fabrics that are designed to resist the chemically-active gas stream characteristics of some combustion processes are also available.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

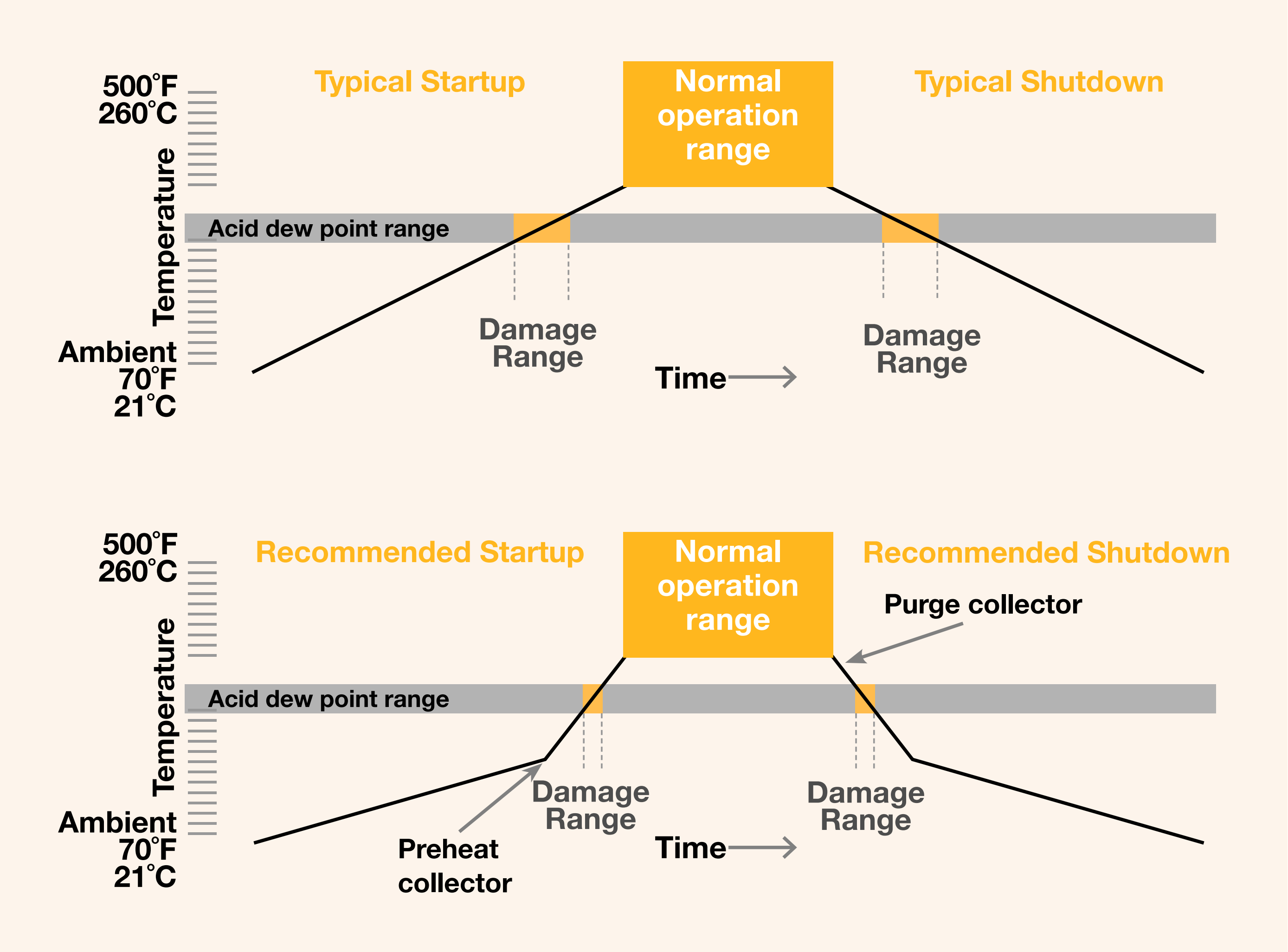


Figure 40. *Startup/shutdown timeline in relation to dew point.*

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

COMBUSTION INDUSTRY

Additional Tools

Particulate Matter Expertise Brochure

METALS INDUSTRY

In this section, we present troubleshooting measures and operational guidelines that have proven to be beneficial to the steel or metal industry. These ideas are intended to supplement the information outlined in the General Troubleshooting section.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US
TABLE OF CONTENTS
ADDITIONAL TOOLS

Steel Mills

Problem: Furnace Changes Overload the Baghouse

Melting a ton of steel in an electric arc furnace (EAF) generates dust and fumes. A general rule of thumb for steelmaking is that for every ton of steel you melt, you get an average of 1–3% (20 to 60 lbs.) of dust. The air volume can be calculated from the heat balance of the process. Once the air volume and dust load are known, it is a simple matter to calculate the quantity of dust per cubic foot of air, which is known as grain loading.

Baghouses are designed based on the gas volume to be filtered and the dust loading in that gas volume. Process changes or additions that increase the size of the heat or shorten the length of the melt cycle may increase the amount of dust to be handled by the system, which can cause the following problems:

- High differential pressure across the baghouse and increased fan motor energy consumption
- Reduced suction at the furnace, making the work area dusty or smoky
- Reduced air volume
- Reduced filter bag life
- Overloading of the hopper evacuation system

The following are the process changes that are most likely to increase grain loading and create baghouse problems:

Oxygen Burners

The steel industry has been adopting oxygen burners to increase production. Adding an oxygen burner to an electric arc furnace increases the heat, which reduces the melt time, but it also increases the grain load the baghouse will have to handle, since the same amount of dust is being generated in less time.

Water-Cooled Panels and Ductwork

Water-cooled panels and ductwork are installed to replace refractory materials in the furnace evacuation system. They allow larger melts by making a larger area available for the charge. Larger melts create more fumes, which can overload the baghouse.

Water leaks from either of these systems can create additional problems, including the formation of a moist dust cake, causing higher differential pressure across the filters and increasing the cleaning frequency. Also, high moisture in the gas stream can cause moist heat hydrolysis that will weaken polyester fibers. In addition, buildup on the dust collector fan wheels can cause vibration and increased maintenance.

Foamy Slag Processes

Coke breeze is injected into the process to form a foamy slag on top of the heat, which acts like a lid to retain the heat of the melt in the furnace. If the injection is too close to the ventilation system, a large percentage of the coke breeze will be carried to the baghouse, increasing the grain load, creating a risk of fire in the dust collector and, more importantly, reducing the formation of the foamy slag. The injection point should be placed on the opposite side of the evacuation system to minimize coke breeze loss and decrease grain loading.

Increased Transformer Size

Increasing the size of the transformer provides more electric energy to the furnace, allowing faster melts that result in more dust to the collection system.

For solutions on how to improve dust collection operation, please refer to the General Troubleshooting section on page 4.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

Problem: Increasing Smelting Furnace Amperage to Increase Production Can Challenge Scrubbers

Aluminum smelters are continuously seeking ways to improve production processes and enhance smelting capacity. Increasing pot amperage can be a cost-effective method to increase production, since it requires minimal capital investment. It may be the only alternative for older furnaces where the footprint must remain mostly the same.

When boosting pot amperage, it's important to determine the resulting increase in gas volume and temperature. Hydrogen fluoride (HF) emissions will also rise, as the increased alumina consumption brings additional moisture and dilution air to the pot, where it reacts with the fluoride-enriched electrolyte. The combination of higher fluoride levels, gas flows and temperatures can increase fugitive emissions. To prevent this, smelters need to find an economical way to make the downstream scrubber (reactor) more efficient.

Solution

BHA Pleated Filter Elements

Pleated filter elements have been successfully installed in existing potline acid gas scrubbing systems to handle these increased volumes, while still maintaining low levels of both gaseous and particulate HF. Pleated filter elements have up to twice the filtration area as a traditional filter bag and cage design and utilize a highly efficient filter medium. This increased filtration area provides a conservative filtration velocity (air-to-cloth ratio) even at elevated gas volumes and reduces energy consumption by lowering filter resistance and reducing cleaning pressures and cleaning frequency. In studies, filter life has increased from as low as 18 months to over 55 months, even with the higher demands.

Most operators are familiar with differential pressure (pressure drop)—resistance to flow caused by the filter media and collected dust cake, measured in inches of water column (WC). A less understood, but equally important concept is “filter drag.” Drag is calculated by dividing pressure drop by flow per unit of area; for example, a potline dry scrubber operating at 6.0" WC at an air-to-cloth ratio of 5 would have a drag equal to 6/5 = 1.2.

Filter drag is especially useful for comparing performance at different gas flow and pressure drop conditions in a system with varying gas flow rates. If flow decreases, the dust cake layer must become thicker to produce the same differential pressure.

If traditional felted filter bags and cages are replaced by pleated filter elements (which contain more filtration area), filter drag calculations can be used to evaluate the effects on retained dust and cleaning cycles. An increased dust layer is desirable for increasing acid gas contact time in fluoride-enriched dry scrubbers.

Installing pleated filter elements in dry scrubber systems can allow aluminum smelters to increase pot amperage and production while still meeting strict emission standards in an economical way.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS
ADDITIONAL TOOLS

Failed Bag Location Chart

Organize baghouse maintenance by using this chart to keep track of the condition and status of each filter bag.

Plant Name: ____________________ Date: ____________

Location: ____________________

Collector: ____________________

Prepared by :____________________

Instructions

1. Orient row numbers with pulse valves.

2. Show orientation of access doors, inlets and outlets.

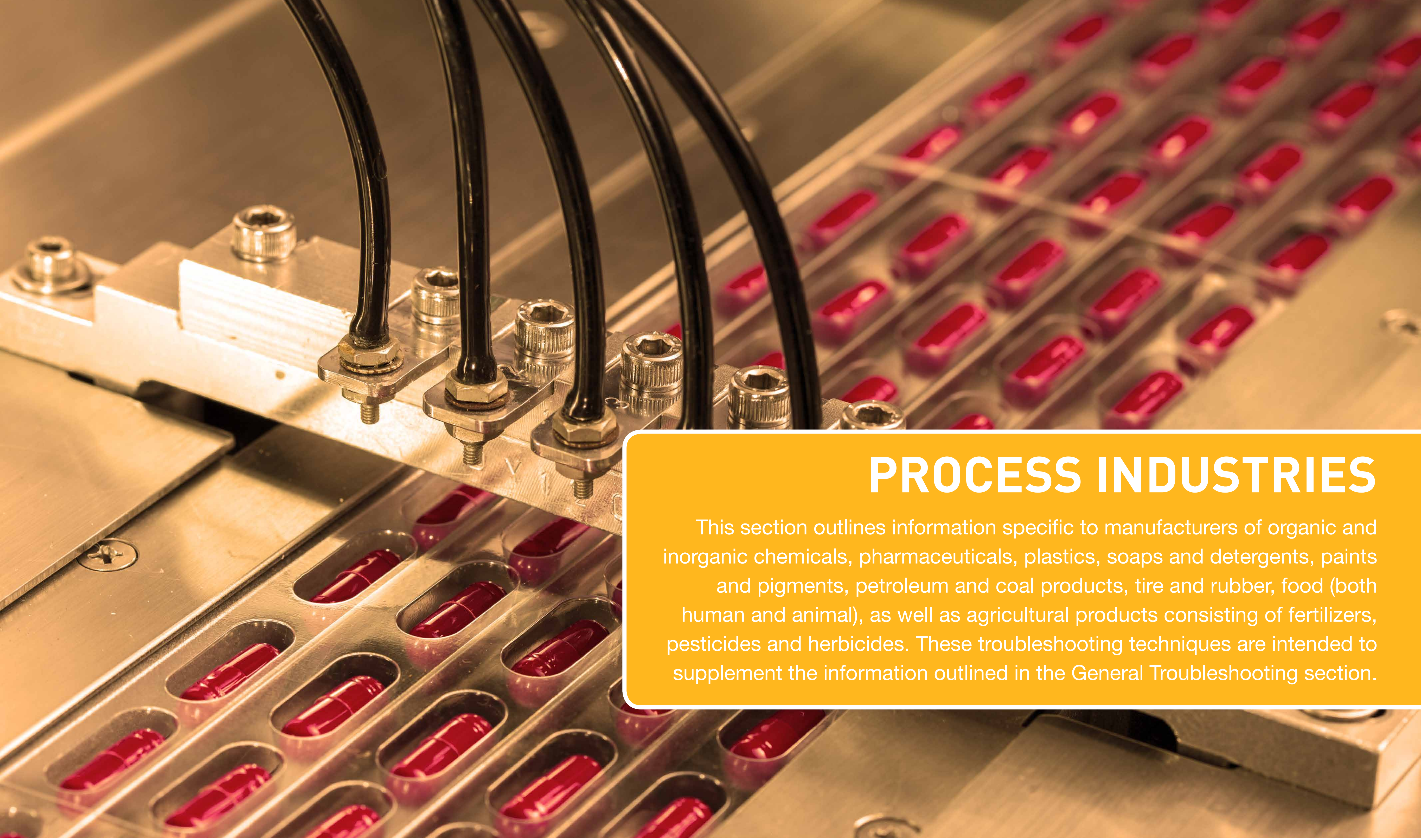
Legend

● Bags with holes: not changed
◐ Leak sealed
⊗ Bags capped off
⊙ Bags needing tension (shaker or reverse air only)
▨ Bags changed this inspection
⊘ Fallen bag re-hung
⊡ Hole in structure

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
3	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
4	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
5	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
6	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
7	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
8	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
9	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
10	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
11	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
12	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
13	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
14	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
15	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
16	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
17	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
18	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
19	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
20	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
21	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
22	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
23	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
24	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
25	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
26	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
27	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
28	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
29	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
30	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
31	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
32	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
33	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
34	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
35	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
36	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
37	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
38	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
39	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
40	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

METALS INDUSTRY

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com



PROCESS INDUSTRIES

This section outlines information specific to manufacturers of organic and inorganic chemicals, pharmaceuticals, plastics, soaps and detergents, paints and pigments, petroleum and coal products, tire and rubber, food (both human and animal), as well as agricultural products consisting of fertilizers, pesticides and herbicides. These troubleshooting techniques are intended to supplement the information outlined in the General Troubleshooting section.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

Parker

ENGINEERING YOUR SUCCESS.

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS
ADDITIONAL TOOLS

Spray Drying

Spray drying is a very common application for dry dust collection within Process Industries. It consists of four basic steps: product preparation, atomization, evaporation and separation.

Beginning with product preparation, the feed slip must be in a liquid or slurry form. In the atomization process, the slurry or slip is pumped under pressure through a spray nozzle or disc atomizer to disperse the slurry into a controlled spray droplet size, typically 20–180 microns. The spray is then contacted and suspended by a heated air stream, causing the liquid in the droplets to rapidly evaporate, leaving only the desired dried solids. This dried solid or powder is then separated from the vapor stream by a dust collector. Finally, the spent drying air and vapor stream are either exhausted to atmosphere or recirculated into the process.

Spray Dryer Configurations

- **Cocurrent** spray dryer configurations are designed for products that need to pass through the system quickly. Both the spray feed and hot gas flow downward through the dryer. The feed is sprayed into the hottest gas, producing nearly instantaneous drying.
- **Countercurrent** models work well to heat treat a product, or with products that require more time in the dryer. As the name implies, the heated gas flows upward and the feed slip sprays downward. This upward flow of air slows the particle settling, allowing for extra drying time.
- **Mixed or fountain flow** dryers direct the hot gas flow downward as the feed sprays upward, so it settles down with the gas. This approach is generally used for larger particles because the particle trajectory is increased, allowing extra drying time (see Figure 41).

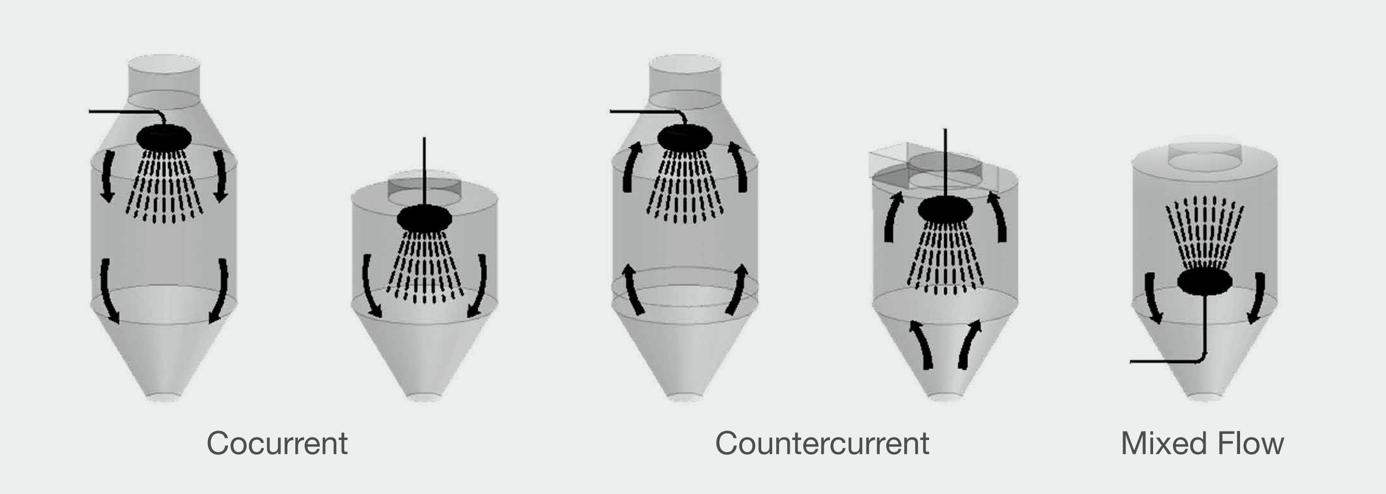


Figure 41. *Spray drying flow patterns.*

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

Problem: Poor Baghouse Performance, Affecting Product Quality and Production Levels

Proper baghouse operation is critical during the drying process. Poor performance can greatly affect both product quality and drying production levels. High differential pressure across the baghouse will not only reduce airflow through the system and slow production, but can also affect the retention time of the particulate in the heated gas stream. The result could be a lower-quality end product.

Maintaining a traditional dust cake on the filter bags used in spray drying systems can be difficult and sometimes undesirable because of continued heat contact. Additionally, when product changes are made, the entire system is often cleaned down and water-washed, including the filter bags. This cleaning process can lead to premature bleed-through and/or bag blinding of the filters during the next process cycle. The constant moisture in the system can also create high differential pressure problems, requiring excessive cleaning of the filters and, with it, reduced filter life.

Solution

Next-Generation Filter Technologies

The filters used in spray dryer dust collectors need to be able to operate properly in high-moisture and aggressive cleaning cycle conditions. Fortunately, next-generation filtration technologies like BHA Preveil microporous ePTFE membranes address these concerns. This microporous laminate is designed to easily release challenging dust cake during normal cleaning cycles, even with high-moisture conditions.

Using an ePTFE membrane also allows for the capture of extremely fine particulate without building or maintaining a traditional dust cake. Plus, the risk of product cross-contamination is dramatically decreased. As a result, these innovative filters operate at a lower overall differential pressure for a longer period of time than traditional media, saving you both downtime and energy cost.

BHA PulsePleat pleated filter elements are also widely used in spray drying applications. Pleated filters' ability to increase the capacity of a spray dryer system without increasing the size of the baghouse permits substantial increases in production and airflow, while reducing housing and interstitial velocities. BHA PulsePleat filters are available in a wide variety of media and with BHA Preveil microporous laminates, as well as other finishes.

Acoustic horns, such as the BHA Powerwave® acoustic cleaning systems, are also a popular modification for both spray dryers and spray dryer baghouses. The acoustic energy helps minimize particulate buildup. Acoustic systems are available in several materials, including stainless steel.

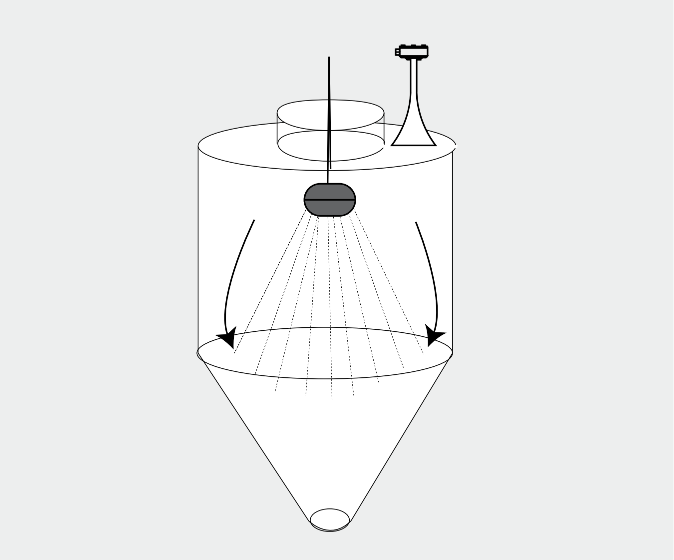


Figure 42. *Acoustic cleaners clean by creating sound waves that break up and dislodge hard-to-remove deposits.*

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

Mixing and Blending

Blending powders and/or products together is one of the oldest and most common applications in any industry. Industrial mixing and blending equipment is used extensively within the Process Industries to mix a vast range of materials and products together, both wet and dry. These mixed products can consist of subcomponents and catalysts for an end product, or can be the end product itself. The mixing and blending process can operate at different temperatures (chilled, ambient temperature or heated) and different pressures (both hydraulic and pneumatic). The equipment used to do this mixing has evolved over the years to better handle materials with various bulk solids properties, to resist scale and buildup, and to control mixing behavior. Specialized mixing systems can even coat individual particles, fuse or agglomerate materials, alter material properties and improve product quality.

Problem: Underventilation and Overventilation

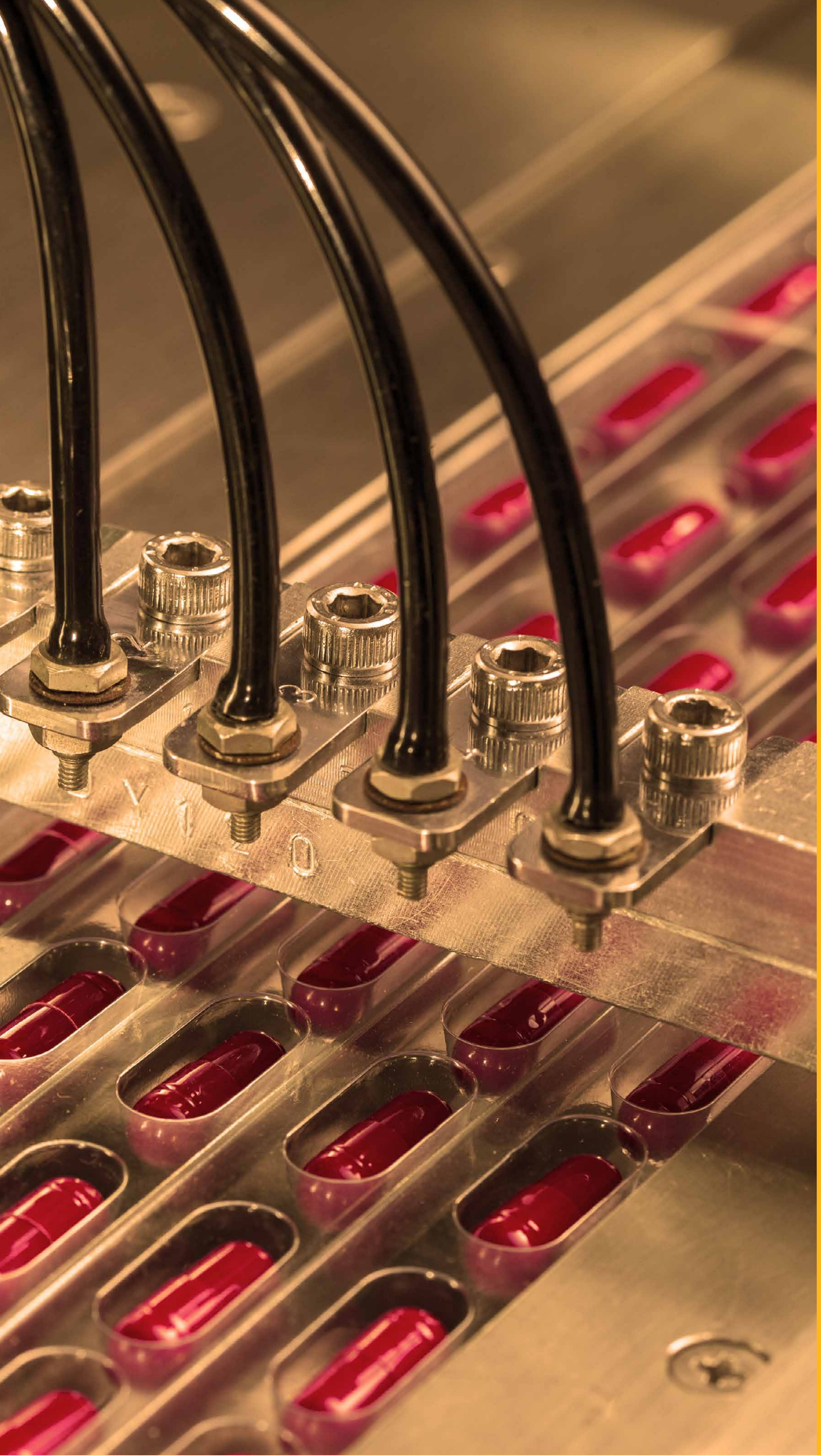
Proper baghouse sizing and operation are important for effective mixing system performance. High differential pressure across the baghouse can reduce airflow through the system, leading to inadequate ventilation of the mixer system and creating dusty work environments, possible OSHA violations and potentially slowing the mix cycle time.

Additionally, poor duct and hooding design can cause overventilation of the mixer system, resulting in loss of product at the mixer and higher grain loading to the baghouse. These issues can also result in end products that do not meet specifications, substantially reduced filter life and increased energy consumption.

Solution

Match the Filter to the Application

Filter fabric and finish should be carefully selected based on the mixing system temperature, gas stream chemistry, average particle size and percentage of moisture in the product and/or system. Pleated filters such as the BHA PulsePleat filter line are widely used in mixing system applications—especially systems that are fed pneumatically or by conveyor—because of their compact size and ability to withstand wide-ranging air surges during operation. Contact your Parker Hannifin | BHA representative at +1.800.821.2222 or +1.816.356.8400 for assistance in selecting the filter media best suited to your specific application.



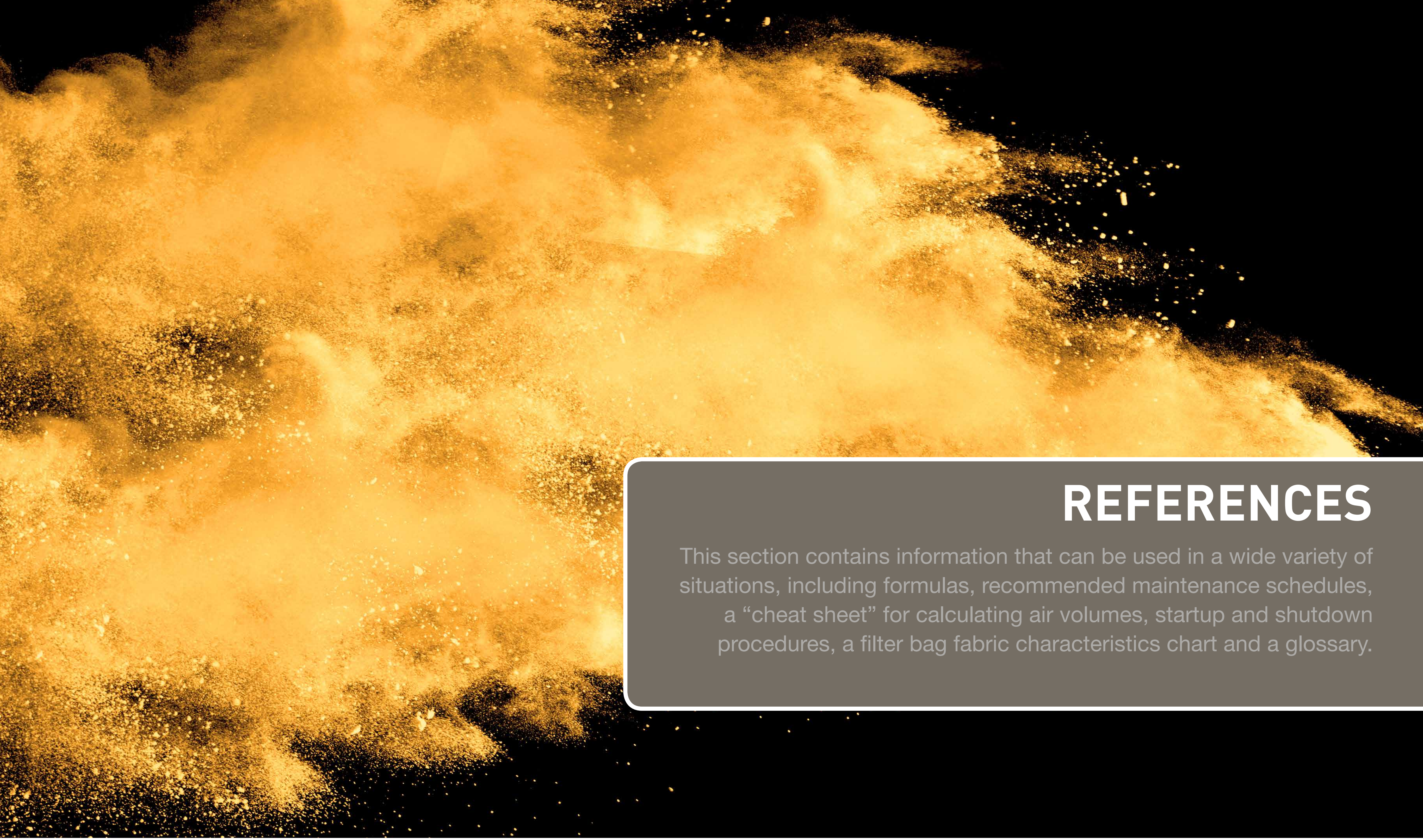
PROCESS INDUSTRIES

Additional Tools

BHA Pleated Filter Elements.

Increased Performance. Maximum Quality.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com



REFERENCES

This section contains information that can be used in a wide variety of situations, including formulas, recommended maintenance schedules, a "cheat sheet" for calculating air volumes, startup and shutdown procedures, a filter bag fabric characteristics chart and a glossary.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

Dust Collection Formulas

ACFM: actual cubic feet per minute
AMP: amperage
Dia: diameter
FPM: feet per minute
L: length
PSI: pounds per square inch
RPM: revolutions per minute
SP: static pressure
SPWG: static pressure water gauge
VP: velocity pressure, inches of water

Total CFM = Velocity *(FPM)* x Duct Area *(ft.^{2})*   **1 CFM** = 1.70 m^3/hr.

Velocity = 4,005$\sqrt{\text{VP}}$ at Standard Conditions (70°F at Sea Level)

Total Cloth Area, ft.^{2} = [(Bag Dia *(in.)* x 3.14 x Bag L *(in.)*) ÷ 144] x Total Number of Bags

Gross Air-to-Cloth Ratio = ACFM ÷ Total Cloth Area *(ft.^{2})*

Net Air-to-Cloth Ratio = ACFM ÷ Total On-Line Cloth Area *(ft.^{2})*

1 in. SPWG = .578 oz./in.^{2} = .0361 PSI = .0735 in. Hg (Mercury)

1 PSI Air Pressure = 27.70 in. SPWG = 2.036 in. Hg = 0.068 Bar = 0.0703 kg/cm^2

Area of a Circle (or Hole) = 3.14 x (radius (ft.))^2 = 3.14 x (diameter (ft.))^2 ÷ 4

Can Velocity = ACFM ÷ [Total Tubesheet Area *(ft.^{2})* – (Hole Area *(ft.^{2})* x Number of Holes)]

7,000 Grains = 1 lb. = 16 oz. = 453.6 grams   **1 lb./ft.^{3}** = 16.02 kg/m^3 **1,000 kg/m^3** = 62.42 lb./ft.^{3}

Grain Loading Expressed in Grains/ft.^{3} = (Lbs. of Dust Handled per Minute x 7,000) ÷ ACFM

1 gram/m^3 = 0.437 grains/ft.^{3}

Lbs. of Dust/Minute = (Grains/ft.^{3} x ACFM) ÷ 7,000

1 m^3/hr. = 0.589 ft.^{3}/min.

1 Horsepower = 0.746 kilowatts

1 inch = 25.4 mm = 0.0254 meter

°C = (°F – 32) x (5/9)   **°F** = [°C x (9/5)] + 32

$$\textbf{ACFM} = \text{SCFM} \times \frac{\text{Actual Temperature (°F)} + 460\text{°F}}{530\text{°F}} \text{ (At Sea Level)}$$

For additional adjustment based on density and relative humidity see the Industrial Ventilation Guide.

$$\textbf{Am}^3\textbf{/hr.} = \text{Nm}^3\text{/hr.} \times \frac{\text{Actual Temperature (°C)} + 273\text{°C}}{273\text{°C}}$$

Fan Laws:
CFM Varies Directly as the RPM:
$RPM_2 = RPM_1 (CFM_2 ÷ CFM_1)$
$CFM_2 = CFM_1 (RPM_2 ÷ RPM_1)$

HP (AMP) Varies as the Cube of the RPM:
$AMP_2 = AMP_1 (RPM_2 ÷ RPM_1)^3$
$RPM_2 = RPM_1 \sqrt{}(AMP_2 ÷ AMP_1)$

SP Varies as the Square of the RPM:
$SP_2 = SP_1 (RPM_2 ÷ RPM_1)^2$
$RPM_2 = RPM_1 \sqrt{}(SP_2 ÷ SP_1)$

BHA Visolite Leak Detection Powder Required: 1 lb./1,000 ft.^{2} cloth area.

BHA Neutralite Filter Bag Precoat Powder Required: 1 lb./20 ft.^{2} cloth area.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

Recommended Maintenance Schedules

Daily Maintenance:

☐ Check pressure drop
☐ Check cleaning system
☐ Check all valves and dampers
☐ Check dust removal
☐ Check emissions
☐ Perform a daily walk-through

Weekly Maintenance:

☐ Check all moving parts on discharge systems and screw conveyor bearings
☐ Check damper operation; bypass and isolation
☐ Spot check bag tensioning on reverse air and shaker bags
☐ Check compressed air lines including line oilers and filters
☐ Blow out U-tube manometer or Photohelic* gauge lines
☐ Check temperature gauge accuracy
☐ Check cleaning sequence—determine that all valves seat properly
☐ Check fan drive components

Monthly Maintenance:

☐ Spot check bag connection condition
☐ Check all moving parts on shaker baghouses
☐ Check fan for corrosion and blade wear
☐ Check all hoses and clamps
☐ Spot check for bag leaks and hoses with a leak detection powder like BHA Visolite system
☐ Inspect baghouse structure for corrosion

Quarterly Maintenance:

☐ Inspect bags thoroughly
☐ Check ducts for dust buildup
☐ Observe damper valves for proper seating
☐ Check gaskets on all doors
☐ Inspect paint on baghouse
☐ Calibrate opacity monitor (if required)
☐ Inspect baffle plate for wear

Annual Maintenance:

☐ Check all welds and bolts
☐ Check hopper for wear
☐ Replace high-wear parts on cleaning system

Note: Typical maintenance schedule for reference. Specific operation and equipment conditions and other considerations may require different and/or more frequent maintenance.

**Trademarks are property of their respective owners.*

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS

Air Volume Cheat Sheet

To determine ventilation air volumes for certain equipment.

Airslide
Need width and total length of the air slide in feet (meters). Multiplying these two dimensions together will give the square feet (square meters) of the air slide. The required air volume is 10 CFM per square foot (182 m^3/hr./m^2) of the air slide, based on these dimensions. This air volume may need to be increased based on the temperature in the air slide.

Bucket Elevator
Need the width and depth of the elevator housing in feet (meters). Multiplying these two dimensions together will give the cross-sectional area of the elevator housing. The required air volume is 100 CFM per square foot (1,828 m^3/hr./m^2) of the elevator housing, based on these dimensions. This air volume may need to be increased based on the temperature in the elevator. Air volume does not depend on the height of the elevator. However, for elevators over 30 feet (10 meters) high, half the volume calculated above should be vented near the top and the other half vented near the bottom. The vent point at the top should be below the head shaft and above the tail shaft of the elevation.

Truck Pumps
Bulk tank trucks that pump into a silo or bin usually have a pump that produces a shared volume of 150 to 650 CFM (255-1,104 m^3/hr.). Get the exact rating, if possible. When the line is cleared of material at the end of the pumping cycle it produces a surge of air, for which we add a surge factor of 100% to this volume (in other words, multiply by 2).For example, 450 CFM x 2 = 900 CFM (765 m^3/hr. x 2 = 1,530 m^3/hr.).

FK Pump System
You'll need to know the model(s) of the compressor(s) that operate the pumps. Example is a C-300 compressor. Multiplying the model number by 5.3 gives the approximate air volume the pump produces in CFM. For a C-300 compressor, it is 300 x 5.3 = 1,590 CFM. (Multiply the model number by 9 to get the air volume in m^3/hr. For this example, 300 x 9 = 2,700 m^3/hr.)

Based on recommendations by OEMs, we add a surge factor of 50% to this volume (in other words, multiply by 1.5). For the above example, 1,590 CFM x 1.5 = 2,385 CFM. (Or, 2,700 m^3/hr. x 1.5 = 4,050 m^3/hr.) This air volume may need to be increased based on the temperature in the system. When multiple compressors and pumps are used, add the air volumes of each together to determine the total volume.

Screen Unit
You'll need to know the width and length of the screen in feet (meters). Air volume does not depend on the number of levels of screens in the unit. Multiplying the above two dimensions together will give the area of the screen in square feet (square meters). The required air volume is 50 CFM per square foot (914 m^3/hr./m^2) of screen, based on these dimensions. This air volume may need to be increased based on the temperature in the screen unit.

Loading Spout
You'll need to know the maximum possible loading rate in tons per hour loaded out and type of material loaded. The required air volume is:

$$\frac{\text{tons/hr. x } 33.3}{\begin{array}{c}\text{aerated bulk density in lbs./ft.}^3\\ \text{+ air from air slides feeding spout}\\ \text{+ air of aeration pads on silo}\end{array}}$$

In metric units:

$$\frac{\text{tons/hr. x } 33.3}{\begin{array}{c}\text{aerated bulk density in kg/m}^3\\ \text{+ air from air slides feeding spout}\\ \text{+ air of aeration pads on silo}\end{array}}$$

The aerated bulk density used for cement is 40 lbs./ft.^{3} (634 kg/m^3). This air volume may need to be increased based on the temperature of the material.

Start Up Procedure For Pulse Jet Baghouse

Objective:

To follow a start-up procedure that minimizes damage to the filterbags and maximizes the filter life.

Why?

For conventional felt filtration medias, the importance of a dust cake as the primary mode of filtration is paramount. A dust cake made up of diverse sized particles captures the ultra fine dust before it penetrates or embeds itself in the felt. If a filterbag does not have a dust cake, either particulate bleed-through or filterbag blinding will result in shortened bag life.

How?

1. The key to controlling a dust cake is the proper operation and set-up of the cleaning mechanism, you must clean based on Differential Pressure.

2. Although differential pressure is a result of baghouse design, air-to-cloth ratio, operating parameters and gas stream conditions, an acceptable industry average is 3.5-5” of differential pressure.

3. Preferred filterbag replacement procedure is to refurbish the entire baghouse, use a pre-coat to establish a dust cake and then bring the unit “on-line”. The cleaning or pulsing should not initiate until the high set point on the D.P. gauge is reached.

4. If a complete refurbish is not an option for your application, you may decide to refurbish on a compartment-by-compartment basis. It must be understood that in comparison to the compartments with the “old” filters, a compartment with new filterbags will start up at significant lower differential pressure. As a result of this lower pressure, your fan will pull much more air through the compartment with the new filters, because air always finds the path of least resistance. This will damage your filters unless:

   a.You can reduce the initial airflow through the compartment using an inlet damper, slowly “seeding” the bags until an acceptable D.P. is achieved. Once desired D.P has been reached, baghouse can operate “as normal”.

   b.Use pre-coat powder injected into the new compartment to establish an artificial initial dust cake. This is also a good way to protect you filters from dew-point related moisture as the pre-coat powder will absorb many times its weight in moisture without agglomerating on the filterbag.

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

TABLE OF CONTENTS

Startup and Shutdown Procedures for Hot Gas Applications

Startup Procedures

Natural Gas
Startup with natural gas until feed is put to the unit. The use of natural gas will minimize the chance of liquid hydrocarbons blinding the filter bags, but with the amount of water in natural gas, condensation and corrosion still need to be addressed. Use the recommendations outlined in this section to pass through the dew point quickly and minimize corrosion.

Diesel Fuel or Coal
The baghouse can be started up with diesel fuel, but be careful to reduce hydrocarbon carryover to the filters. The startup procedures listed below will decrease, but not eliminate, the chance of blinding the filter bags with raw fuel or hydrocarbon carryover. Starting up with coal will minimize the chance of hydrocarbon contamination, but the following procedures should still be used.

Multiple Compartments
Bring one compartment on-line at a time. This is done because during warm-up, the full volume of the dust collector is not needed. Because the volume is reduced, the velocities through the baghouse are reduced. Therefore, if the entire baghouse is on-line it takes quite a while for the collector to come up to temperature, resulting in the compartments operating in the dew point for an extended period. Bringing the baghouse on-line one or two compartments at a time brings the temperature in the compartments up quickly, so they pass through the dew point quickly.

Start with one or two of the compartments furthest from the process on-line and the cleaning system turned off. As the differential pressure gets higher and the temperature comes up to a level above dew point, add the next compartment, working forward to the compartments closest to the process. Inject Neutralite powder into each compartment as it is brought on-line. Continue this procedure until all compartments are on-line.

Do not start the cleaning cycle until the process dust is entering the baghouse and the pressure drop has increased by 1"–3". Some people refer to this procedure as starting up with “sacrificial compartments,” although ideally no bags are sacrificed. It will be very important to turn off the fuel if the flame goes out during the warm-up period.

When all the compartments are on-line and dust loading to the baghouse has begun, start the cleaning system, which should always be controlled by differential pressure. Cleaning set points need to be determined based on the individual system, with the low and high set points no more than 1", and preferably ½", apart.

Single-Compartment Units
One-compartment collectors have to be brought on-line all at once. It is imperative to protect the filter bags by precoating them with BHA Neutralite powder. Also, the cleaning should be off until feed is put to the process equipment and material is entering the collector.

As with multiple-compartment units, the cleaning should be controlled by differential pressure. This will keep the baghouse from cleaning too soon and exposing the filters to moisture contamination. Cleaning set points need to be determined based on the individual system, with the low and high set points no more than 1", and preferably ½", apart. Normally, a pressure drop of ≤ 5" should be maintained, although it could range from 4"–8", depending on the application and design of the baghouse.

Shutdown Procedures

- Stop the cleaning system.
- Let the fan run for another 15 minutes to purge the moisture-laden gases.
- Clean every row of bags (or every compartment on reverse-air systems) for at least two complete cleaning cycles while removing dust from hoppers.
- Make sure all dust has been removed from the hoppers.
- Complete one additional cleaning cycle and remove dust from hoppers.
- Close inlet and outlet dampers and all access doors while the unit will be off-line.

Note: Always follow manufacturer’s instructions and applicable safety procedures.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

TABLE OF CONTENTS

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

BHA Filter Bag Fabric Characteristics Chart

We can deliver most any type of filter bag for your baghouse, regardless of OEM design and system conditions. The charts below specify the most popular styles, fabrics and finishes, and the conditions they are most suited to handle.

Fabrics	Polypropylene	Acrylic	Polyester	PPS	Aramid	P84†	Fiberglass	PTFE Felt	Cellulose/ Polyester Blend
Maximum Continuous Operating Temperature	170° F (77° C)	265° F (130° C)	275° F (135° C)	375° F (190° C)	400° F (204° C)	500° F (260° C)	500° F (260° C)	500° F (260° C)	200° F (93° C)
Abrasion	Excellent	Good	Excellent	Good	Excellent	Fair	Fair	Good	Good
Energy Absorption	Good	Good	Excellent	Good	Good	Fair	Good	Good	Good
Filtration Properties	Good	Good	Excellent	Excellent	Excellent	Fair	Excellent	Fair	Good
Moist Heat	Excellent	Excellent	Poor	Good	Good	Excellent	Good	Excellent	Fair
Alkalines	Excellent	Fair	Fair	Excellent	Good	Fair	Fair	Excellent	Poor
Mineral Acids	Excellent	Good	Fair	Excellent	Fair	Poor	Good	Excellent	Poor
Oxygen (15%+)	Excellent	Excellent	Excellent	Poor	Excellent	Excellent	Excellent	Excellent	Excellent

†Sensitive bag-to-cage fit. *††Fair with chemical- or acid-resistant finishes.* *†††Must oversize bag for shrinkage for temperatures above 450°F (232°C).*

	Finishes	Finish Purpose	Available For
Non-fiberglass	**BHA Preveil ePTFE Membrane**	For capture of fine particulate, improved filtration efficiency, cake release and airflow capacity	Polyester, Aramid, Acrylic, Polypropylene (felt and woven), P84, PPS, Teflon/PTFE
	Singe	Recommended for improved cake release	Polyester, Polypropylene, Acrylic, Aramid, PPS, P84 (felts)
	Glaze/Eggshell	Provides short-term improvements for cake release (may impede airflow)	Polyester, Polypropylene (felts)
	Silicone	Aids initial dust cake development and provides limited water repellency	Polyester (felt and woven)
	Flame Retardant	Retards combustibility (not flame-proof)	Polyester, Polypropylene (felt and woven)
	Acrylic Coatings (Latex Base)	Improved filtration efficiency and cake release (may impede airflow in certain applications)	Polyester and Acrylic felts
	PTFE Penetrating Finishes	Improved water and oil repellency; limited cake release	Polyester, Aramid (felt), PPS

	Finishes	Finish Purpose	Applications
Fiberglass	**BHA Preveil ePTFE Membrane**	For capture of fine particulate, improved filtration efficiency, cake release and airflow capacity	Cement/lime kilns, incinerators, coal-fired boilers, cupola, ferrosilica/alloy, furnace
	Silicone, Graphite, ePTFE	Protects glass yarns from abrasion, adds lubricity	For non-acid conditions, primarily for cement and metal foundry applications
	Acid Resistant	Helps shield glass yarn from acid attack to extend life	Coal-fired boilers, carbon black, incinerators, cement, industrial and boiler applications
	ePTFE	Provides enhanced fiber-to-fiber resistance to abrasion and limited chemical resistance	Industrial and utility base load boilers under mild pH conditions, cement and lime kilns
	Blue Max CRF-70*	Provides improved acid resistance and reduces fiber-to-fiber abrasion, resistant to alkaline attack, improved fiber encapsulation	Coal-fired boilers (high and low sulfur) for peak load utilities, fluidized bed boilers, carbon black, incinerators

*The information above is provided as a general guideline. Varying sets of conditions may affect performance. Other specialty finishes may be available. *Trademarks are property of their respective owners.*

TABLE OF CONTENTS
GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

Glossary

ACFM
Actual cubic feet of gas per minute; the volume of the gas flowing per minute at the operating temperature, pressure, moisture and composition.

The metric equivalent is expressed in terms of m³/min. at actual pressure, temperature and moisture.

AGGLOMERATION
Multiple particles joining or clustering together by surface tension to form larger particles, usually held by moisture, static charge or particle architecture.

AIR-TO-CLOTH (A/C) RATIO
The ratio between ACFM flowing through a filter and the sq. ft. of filter area available. This can also be thought of as the velocity of the gas passing through the filter in feet per minute (FPM).

Note: *In the metric system the term used is "filtration velocity," defined as the relation between the m³/min. of air flowing through a filter and the m² of filter area available.*

Typical A/C ratios and filtration velocities for various types of systems are:

Cleaning Type	Air-to-Cloth Ratio	Filtration Velocity (m/min.)
Shaker	2.5-3.0 : 1	0.76-0.91
Reverse-Air	1.5-2.5 : 1	0.61-0.76
Plenum Pulse	3.5-4.0 : 1	1.07-1.22
Pulse Jet with Filter Bags:		
Nuisance Venting	4.5–5.5:1	1.37–1.67
Process Equipment	3.5–4.5:1	1.07–1.37
High Dust Load (> 50 grains/ACF)	3.0–4.5:1	0.91–1.37
Hot Gas Applications (350°F–500°F)	3.0–4.5:1	0.91–1.37
Pulse Jet with Pleated Filters:		
Nuisance Venting	3.0–3.5:1	0.91–1.07
Process Equipment	2.5–3.0:1	0.76–0.91
High Dust Load (> 50 grains/ACF)	2.0–2.5:1	0.61–0.76
Hot Gas Applications (350°F–500°F)	2.5–3.0:1	0.76–0.91

BLEEDTHROUGH
Particulate migration completely through the interstices of the filter.

BLINDING
Fabric blockage by dust, fume or liquid not being discharged by the cleaning mechanism, resulting in a reduced gas flow because of the increased pressure drop across the filter media.

CAN VELOCITY
The upward air stream speed passing between the filters in a dust collector with the filter elements suspended from the tubesheet, calculated at the horizontal cross-sectional plane of the collector housing at the bottom of the filters.

CAPTURE VELOCITY
The minimum hood-induced air velocity necessary to capture and convey a dust particle into the hood.

CELL PLATE (TUBESHEET)
A steel plate to which the open end of the filter bags is connected; separates the clean air and dirty air plenums of the baghouse.

CLOTH AREA
Diameter of the filter bag x height x ϖ for each filter bag. For total cloth area of the baghouse, multiply the cloth area of each filter bag x total number of bags.

CONVEYING VELOCITY
The gas velocity required to keep a dust particle entrained in the gas stream. The conveying velocity varies based on the particulate in the gas stream.

DEPTH FILTRATION
Refers to particulate passing the surface of a filter and then being captured in the "depth" of the filter. Typically applies to felt filters.

DIFFERENTIAL PRESSURE (ΔP)
The pressure drop across a component or device located within the gas stream; the difference between static pressures measured at the inlet and outlet of a component, compartment or device (i.e., between the dirty and clean sides of filter bags and tubesheet).

DUST CAKE
Buildup on the filtration side of the fabric that is required to improve the filtration efficiency. (Filters with PTFE membrane do not require a dust cake to provide efficient filtration.)

FILTER DRAG
The ratio of differential pressure across the filters (in inches WC) to velocity through the filters (FPM).

GRAIN LOADING
The amount of particulate by weight in a given volume of air, expressed in grains/ft.³. 1 lb. or 0.454 kg = 7,000 grains.

INCHES OF MERCURY
A measurement defined as the pressure exerted by a column of mercury of 1" in height at 32°F (0°C) at the standard acceleration of gravity.

INCHES OF WATER
A unit of pressure equal to the pressure exerted by a column of liquid water one inch high at standard conditions (70°F or 21°C @ sea level); 27.7 inches of water (703 mm WC) = 1 PSA (69 mbar); usually expressed as INCHES WATER GAUGE (WG) or INCHES WATER COLUMN (WC).

TABLE OF CONTENTS

GENERAL TROUBLESHOOTING

CEMENT INDUSTRY

COMBUSTION INDUSTRY

METALS INDUSTRY

PROCESS INDUSTRIES

REFERENCES

FLOWCHART

ABOUT US

Glossary

MAGNEHELIC* GAUGE
An instrument used to measure the differential pressure drop in a baghouse.

MANOMETER
A U-shaped tube filled with a specific liquid, used to measure differential pressure. The difference in height between the liquid in each leg of the tube indicates the difference in pressure on each leg.

MICRON
A unit of length, 1/25,000 of an inch (1/1,000 of one millimeter). Typically used as a measurement of the diameter of particles in the inlet gas of a baghouse.

PHOTOHELIC* GAUGE
An instrument used to measure differential pressure and control it with adjustable set points.

PULSE DURATION/ON TIME
The length of time a pulse lasts, generally described as the length of time the electrical signal holds the solenoid pilot valve open. However, due to mechanical losses, the time the diaphragm is actually open will vary.

PULSE FREQUENCY/OFF TIME
The time between pulses in a pulse-jet baghouse.

PSI
Pounds per square inch; a unit of pressure; 1 PSI equals 27.7 in. WG or 2.04 in. mercury (Hg); can be actual or gauge pressure. In the metric system, this is measured as kg/cm^2. (The conversion is kg/cm^2 x 14.22 = PSI.)

RE-ENTRAINMENT
The phenomenon whereby dust which has been removed from the gas stream is returned to the gas stream. It occurs as a result of excessive velocity or cleaning problems.

SCFM
Standard cubic feet per minute. The volume of dry gas flow per minute at standard temperature and pressure conditions (70°F @ sea level).

The metric equivalent is NORMAL VOLUME—Actual gas volume corrected to 0°C, 1 atmosphere; generally excludes moisture.

STATIC PRESSURE
The negative or positive pressure on the components of a system. Static pressure is generally stated in inches of water (or, in high-pressure systems, inches of mercury). Sometimes referred to as the “suction” (negative) or “bursting” (positive) pressure.

SURFACE FILTRATION
Capturing particulate on the surface of the filter, such as with filters that have a PTFE membrane laminated to the filter surface.

TOTAL PRESSURE
The sum of the static pressure and the velocity pressure at the same point in a system.

VELOCITY PRESSURE
The pressure required to accelerate air or gas from zero velocity to a given velocity.

VENTURI
A cone-shaped device located at the top of each filter in pulse-jet dust collectors into which compressed air is blown. A negative pressure at the top of the venturi is created during pulsing to help pull additional air volume into the filter element.

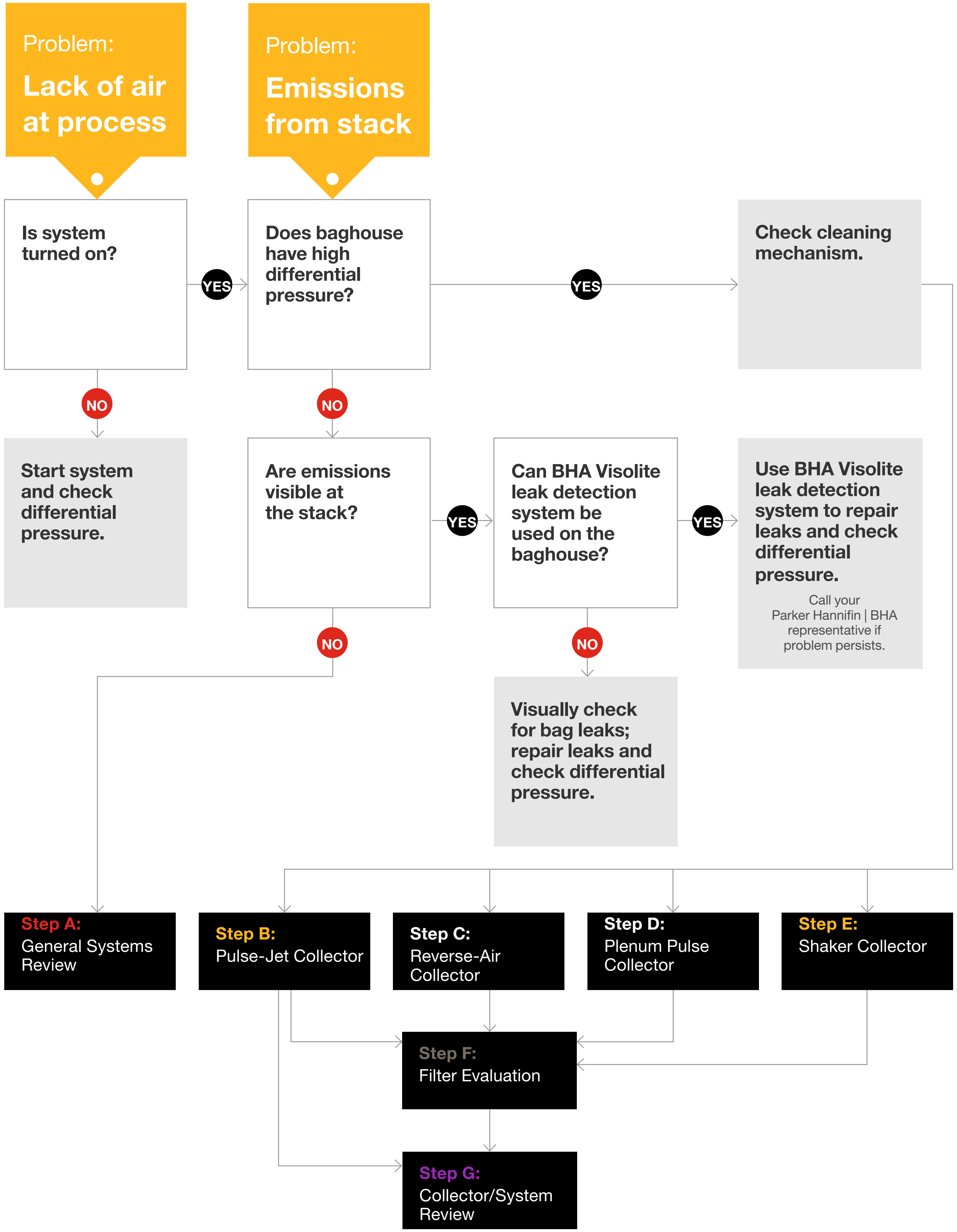
**Trademarks are property of their respective owners.*

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

Dust Collector System

Troubleshooting Flowchart



Problem: **Lack of air at process**

Problem: **Emissions from stack**

Is system turned on?

YES → **Does baghouse have high differential pressure?**

YES → **Check cleaning mechanism.**

NO → **Start system and check differential pressure.**

NO → **Are emissions visible at the stack?**

YES → **Can BHA Visolite leak detection system be used on the baghouse?**

YES → **Use BHA Visolite leak detection system to repair leaks and check differential pressure.**

Call your Parker Hannifin | BHA representative if problem persists.

NO → **Visually check for bag leaks; repair leaks and check differential pressure.**

NO → **Step A:** General Systems Review

Step B: Pulse-Jet Collector

Step C: Reverse-Air Collector

Step D: Plenum Pulse Collector

Step E: Shaker Collector

Step F: Filter Evaluation

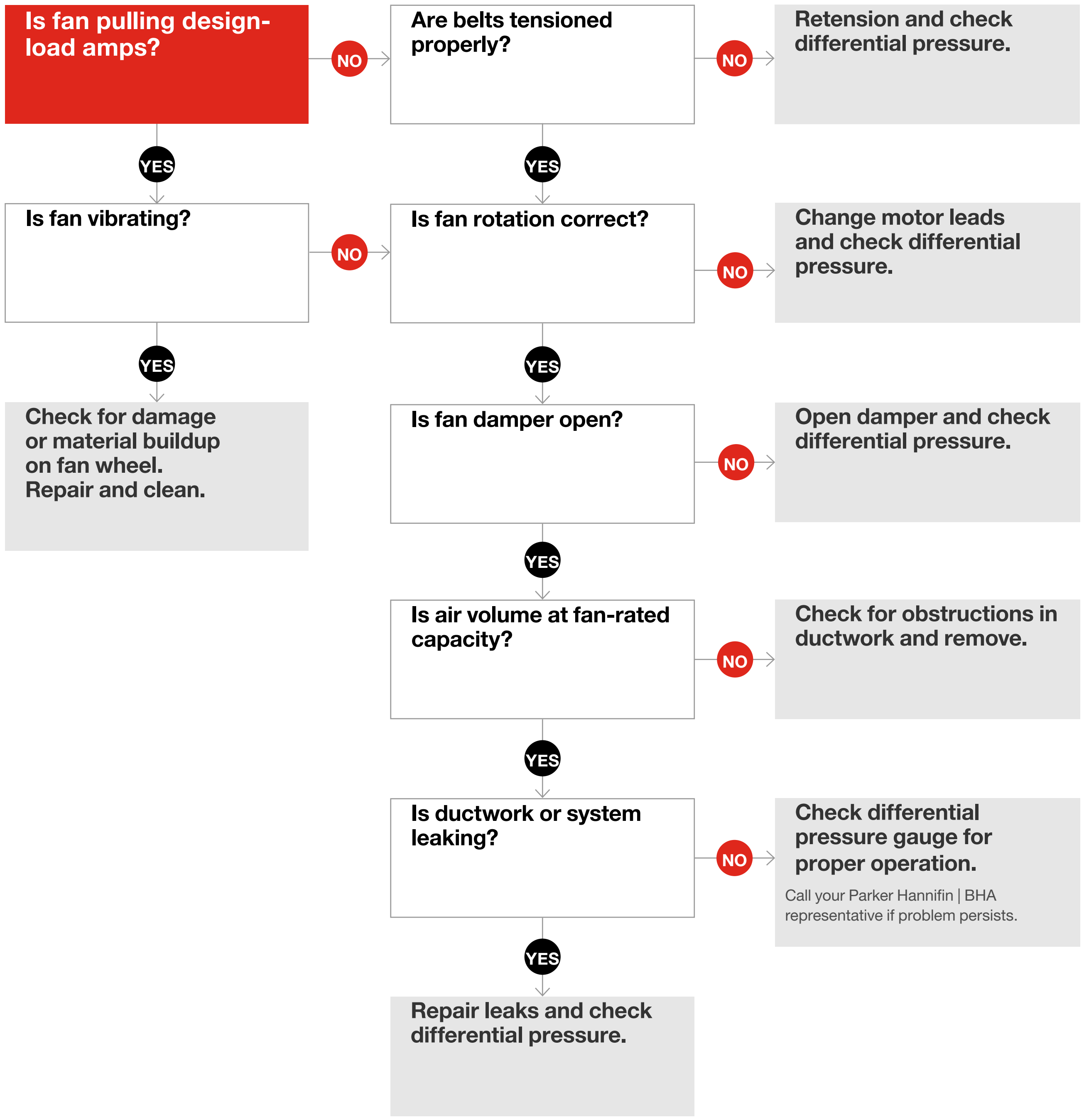
Step G: Collector/System Review

TABLE OF CONTENTS

Step A: General Systems Review

Troubleshooting Flowchart

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US



Is fan pulling design-load amps?

Are belts tensioned properly?

Retension and check differential pressure.

Is fan vibrating?

Is fan rotation correct?

Change motor leads and check differential pressure.

Check for damage or material buildup on fan wheel. Repair and clean.

Is fan damper open?

Open damper and check differential pressure.

Is air volume at fan-rated capacity?

Check for obstructions in ductwork and remove.

Is ductwork or system leaking?

Check differential pressure gauge for proper operation.

Call your Parker Hannifin | BHA representative if problem persists.

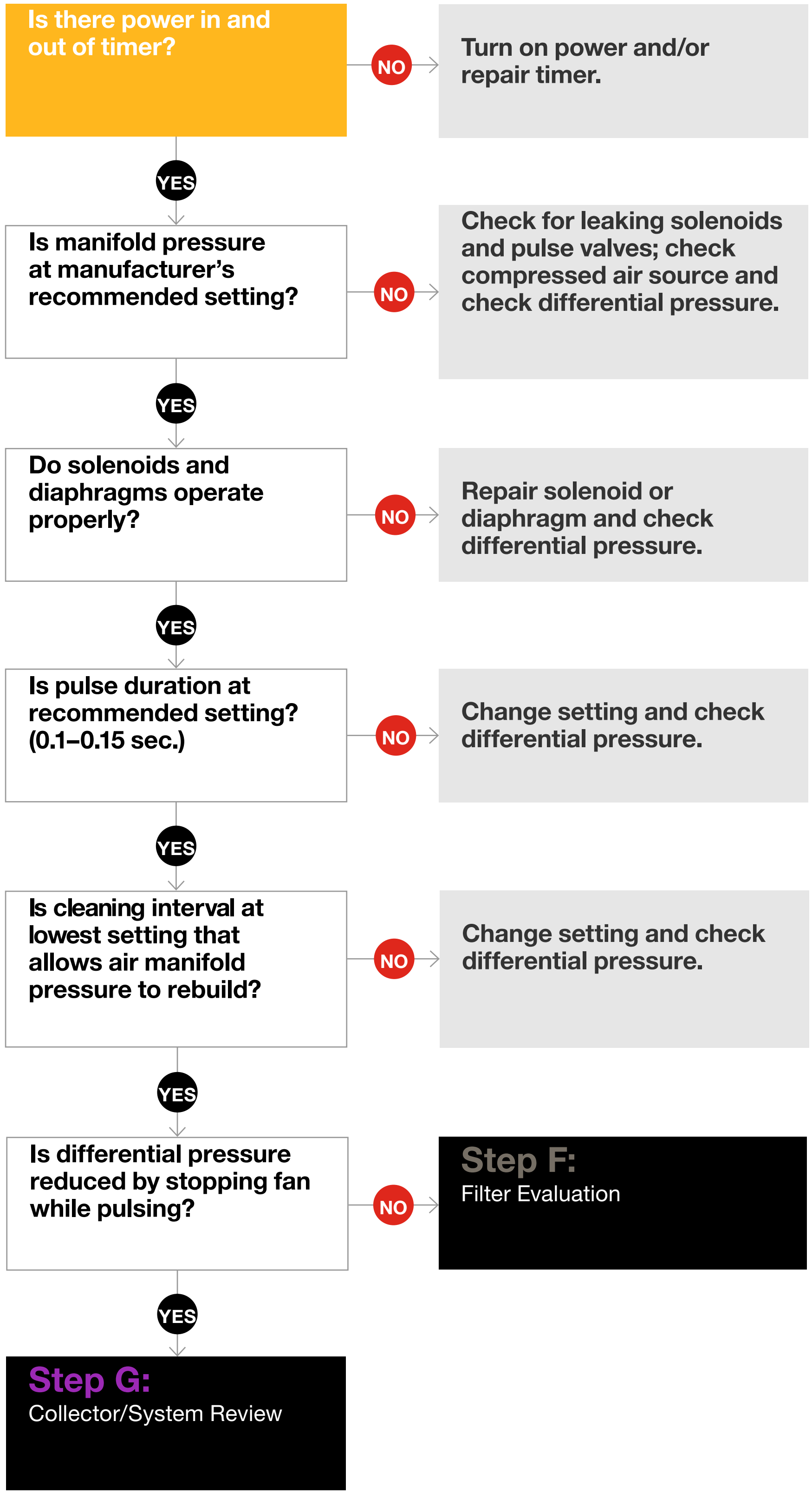
Repair leaks and check differential pressure.

TABLE OF CONTENTS

Step B: Pulse-Jet Collector

Troubleshooting Flowchart

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US



Is there power in and out of timer?
NO → Turn on power and/or repair timer.
YES ↓

Is manifold pressure at manufacturer's recommended setting?
NO → Check for leaking solenoids and pulse valves; check compressed air source and check differential pressure.
YES ↓

Do solenoids and diaphragms operate properly?
NO → Repair solenoid or diaphragm and check differential pressure.
YES ↓

Is pulse duration at recommended setting? (0.1–0.15 sec.)
NO → Change setting and check differential pressure.
YES ↓

Is cleaning interval at lowest setting that allows air manifold pressure to rebuild?
NO → Change setting and check differential pressure.
YES ↓

Is differential pressure reduced by stopping fan while pulsing?
NO → **Step F:** Filter Evaluation
YES ↓

Step G: Collector/System Review

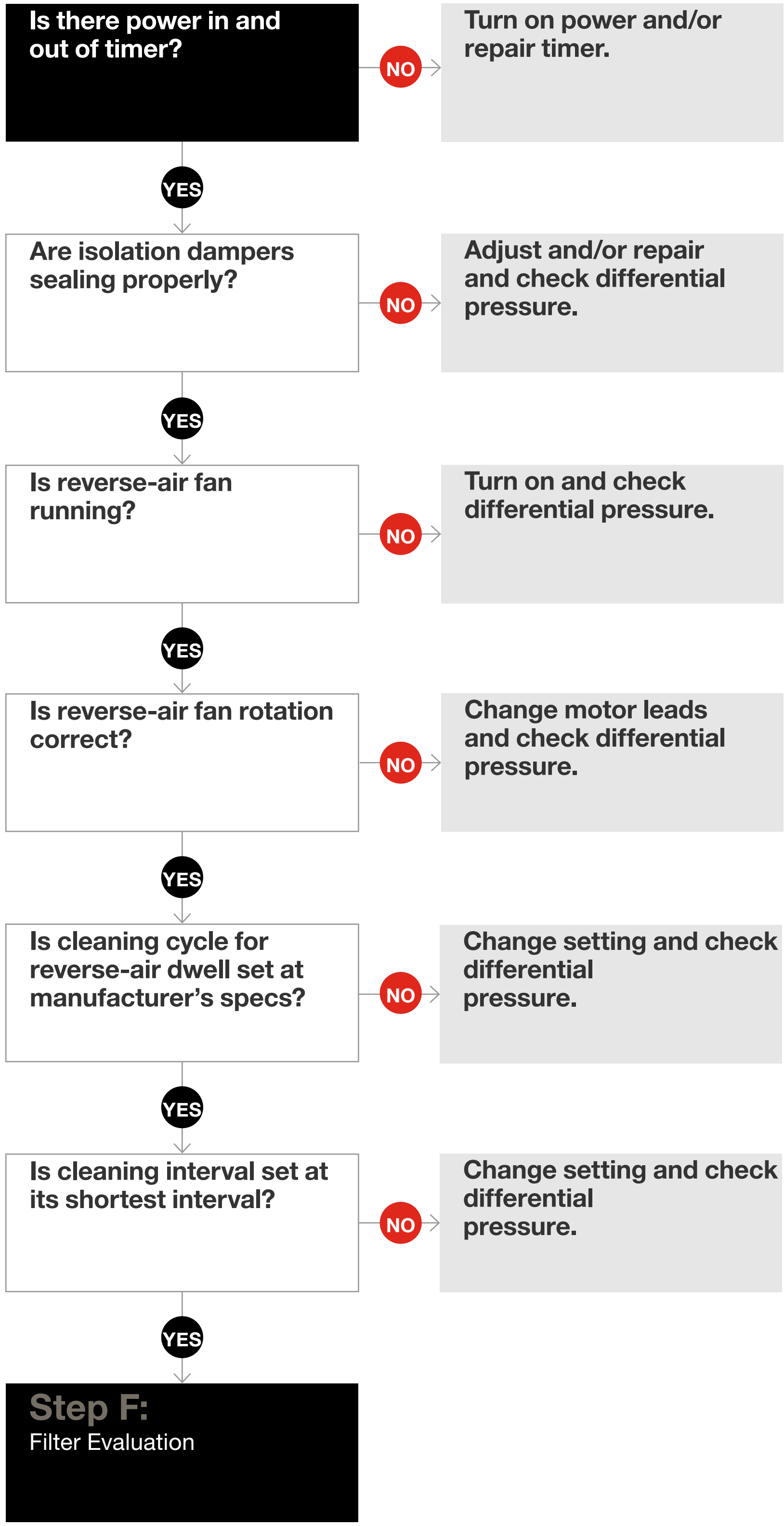
Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

TABLE OF CONTENTS

Step C: Reverse-Air Collector

Troubleshooting Flowchart

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US



Is there power in and out of timer?
- NO → **Turn on power and/or repair timer.**
- YES ↓

Are isolation dampers sealing properly?
- NO → **Adjust and/or repair and check differential pressure.**
- YES ↓

Is reverse-air fan running?
- NO → **Turn on and check differential pressure.**
- YES ↓

Is reverse-air fan rotation correct?
- NO → **Change motor leads and check differential pressure.**
- YES ↓

Is cleaning cycle for reverse-air dwell set at manufacturer’s specs?
- NO → **Change setting and check differential pressure.**
- YES ↓

Is cleaning interval set at its shortest interval?
- NO → **Change setting and check differential pressure.**
- YES ↓

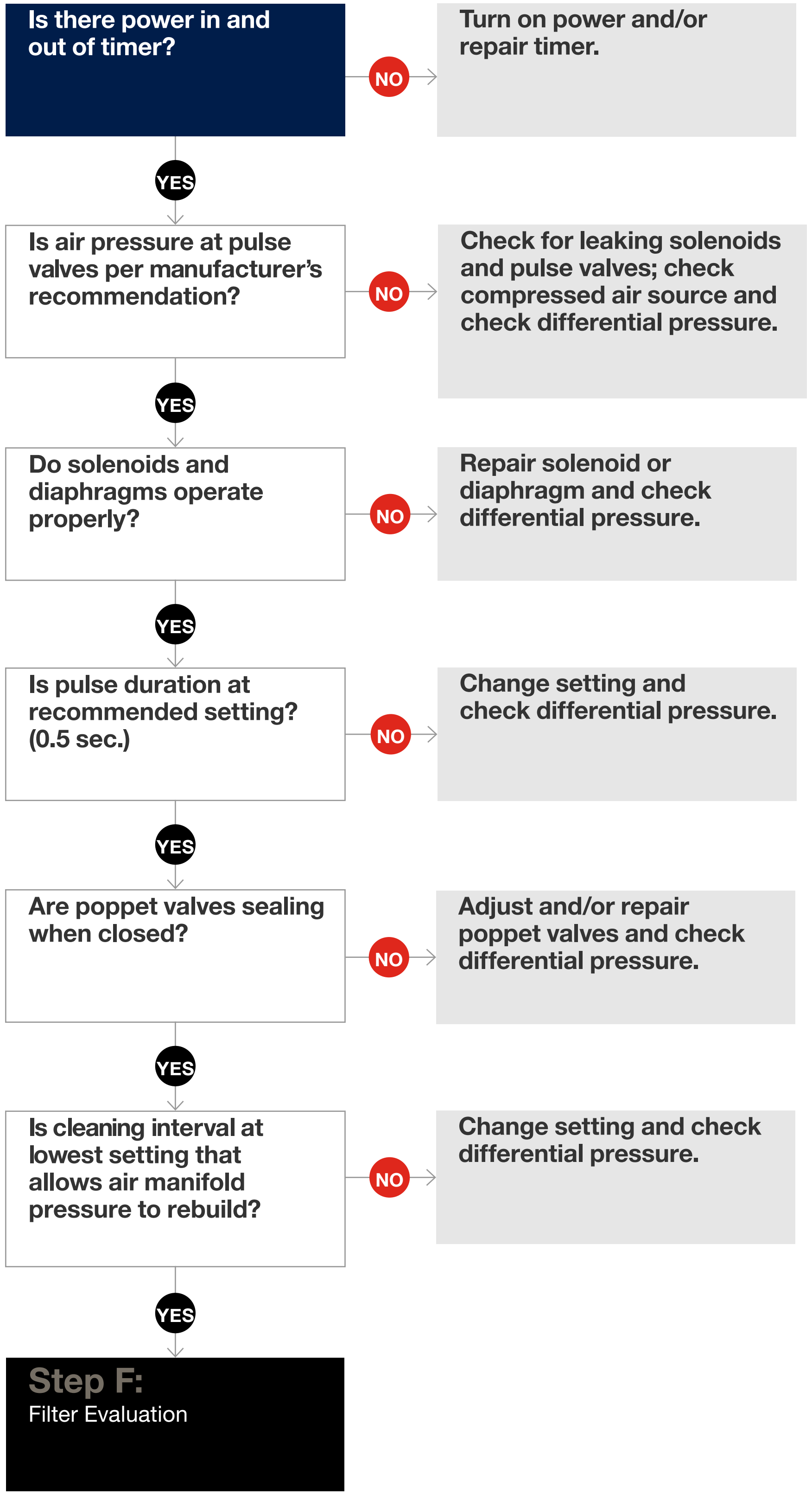
Step F:
Filter Evaluation

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

Step D: Plenum Pulse Collector

Troubleshooting Flowchart

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US



Is there power in and out of timer?
NO → Turn on power and/or repair timer.
YES ↓

Is air pressure at pulse valves per manufacturer's recommendation?
NO → Check for leaking solenoids and pulse valves; check compressed air source and check differential pressure.
YES ↓

Do solenoids and diaphragms operate properly?
NO → Repair solenoid or diaphragm and check differential pressure.
YES ↓

Is pulse duration at recommended setting? (0.5 sec.)
NO → Change setting and check differential pressure.
YES ↓

Are poppet valves sealing when closed?
NO → Adjust and/or repair poppet valves and check differential pressure.
YES ↓

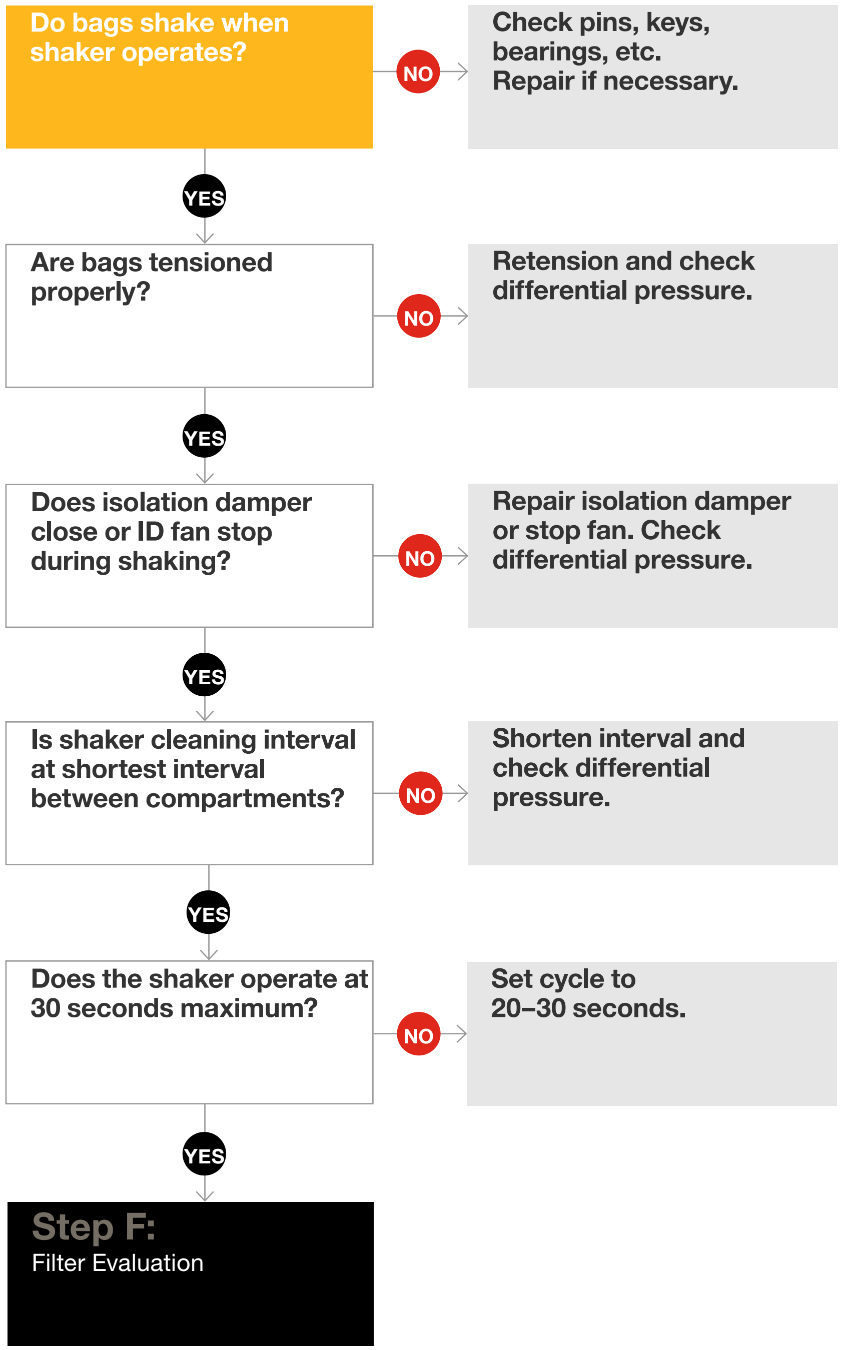
Is cleaning interval at lowest setting that allows air manifold pressure to rebuild?
NO → Change setting and check differential pressure.
YES ↓

Step F:
Filter Evaluation

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

Step E: Shaker Collector

Troubleshooting Flowchart



Do bags shake when shaker operates?
NO → **Check pins, keys, bearings, etc. Repair if necessary.**
YES ↓

Are bags tensioned properly?
NO → **Retension and check differential pressure.**
YES ↓

Does isolation damper close or ID fan stop during shaking?
NO → **Repair isolation damper or stop fan. Check differential pressure.**
YES ↓

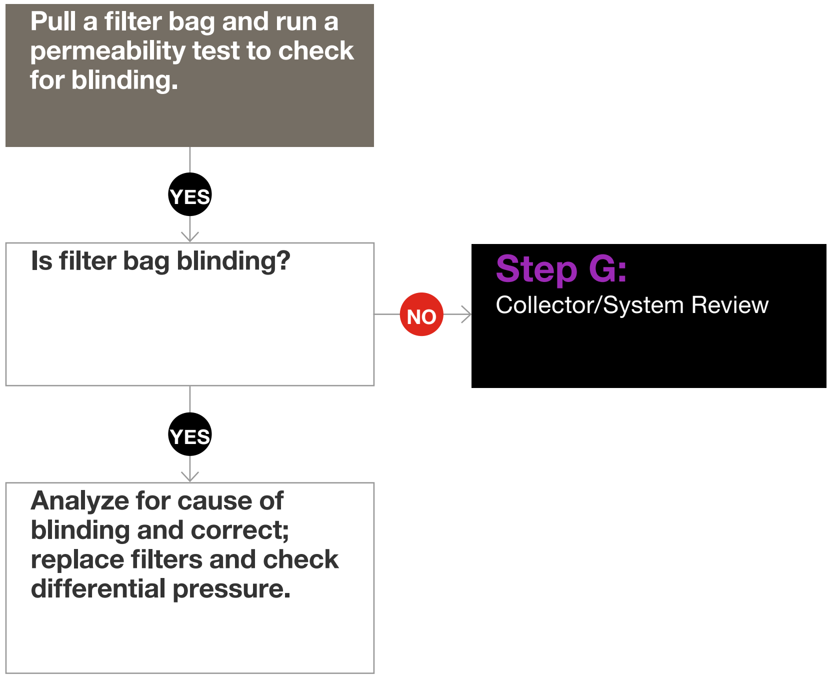
Is shaker cleaning interval at shortest interval between compartments?
NO → **Shorten interval and check differential pressure.**
YES ↓

Does the shaker operate at 30 seconds maximum?
NO → **Set cycle to 20–30 seconds.**
YES ↓

Step F:
Filter Evaluation

Step F: Filter Evaluation

Troubleshooting Flowchart



Pull a filter bag and run a permeability test to check for blinding.

Is filter bag blinding?

Step G:
Collector/System Review

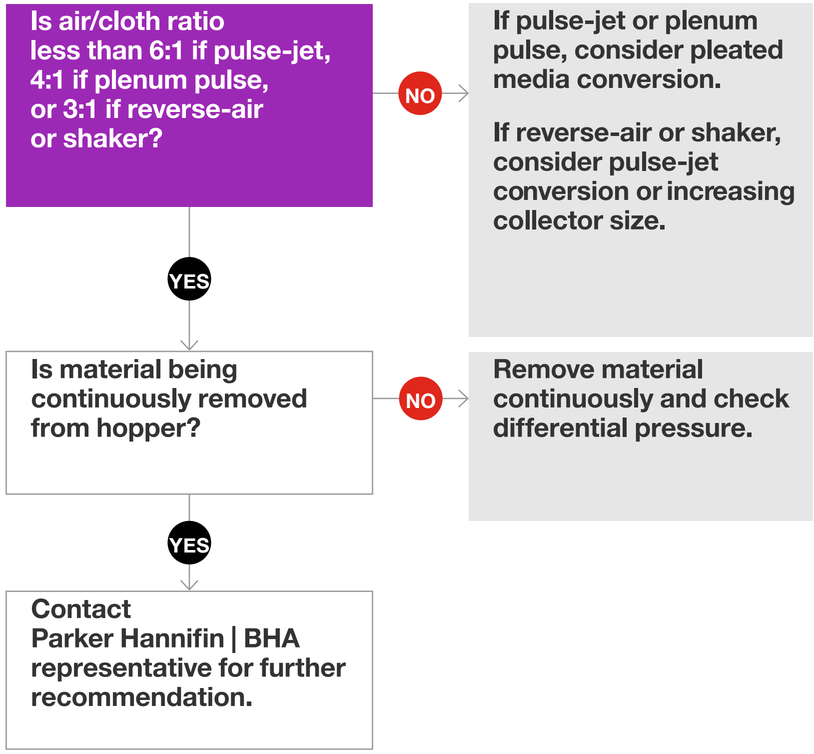
Analyze for cause of blinding and correct; replace filters and check differential pressure.

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US
TABLE OF CONTENTS

TABLE OF CONTENTS

Step G: Collector/System Review

Troubleshooting Flowchart



Is air/cloth ratio less than 6:1 if pulse-jet, 4:1 if plenum pulse, or 3:1 if reverse-air or shaker?

If pulse-jet or plenum pulse, consider pleated media conversion.

If reverse-air or shaker, consider pulse-jet conversion or increasing collector size.

Is material being continuously removed from hopper?

Remove material continuously and check differential pressure.

Contact Parker Hannifin | BHA representative for further recommendation.

GENERAL TROUBLESHOOTING
CEMENT INDUSTRY
COMBUSTION INDUSTRY
METALS INDUSTRY
PROCESS INDUSTRIES
REFERENCES
FLOWCHART
ABOUT US

Protecting Your Assets and Ensuring Purity for Our World

We protect and purify using diverse solutions engineered for your unique application. Never failing you is where we build our pride. We use our expertise to find the best filtration solution for your specific business goals. Our knowledge and filtration expertise are what sets us apart. We always bring the next generation of technologies to the market.

State-of-the-art labs. Advanced filtration research. A leading global provider of innovative filtration technologies and solutions offering superior industry knowledge, thought leadership and exceptional customer service, with a passion for building high-performance products ensuring a safer, cleaner and more sustainable environment.

World-class manufacturing processes. You will find we produce top quality filtration solutions through rigorous manufacturing methods. And, as a global company with an expansive network strategically located around the world, we provide superior localized services and support to you.

Application engineering experience for any filtration challenge. Our ability to design a solution to fit your application begins with engineering expertise; proven by hundreds of global installations supported by local teams with application and industry experience to deliver the industry-leading performance you expect.

We Are Your Filtration Resource

Aftermarket Dust Collection Filters and Parts

We know you value and trust our quality, technical expertise, and industry-leading design and innovation when it comes to dust collection and air filtration. We take that trust very seriously. That means we don't sell just any solution. We work hard to understand your specific needs to provide the right answer. That commitment that honesty is fundamental to what we do. It's at our core. It's who we are.

Fischer-Robertson, Inc.
3890 Symmes Road
Hamilton, OH 45015
ph 513-860-3445
fx 513-860-4744
www.fischer-robertson.com

ENGINEERING YOUR SUCCESS.