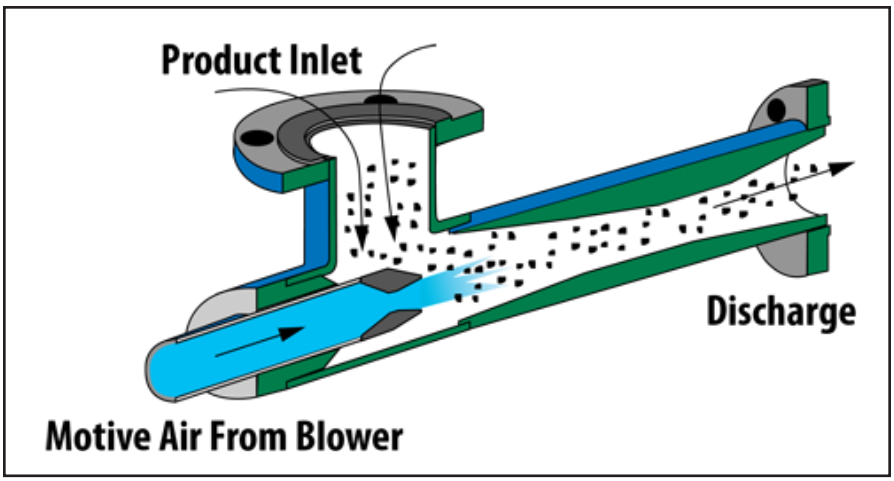
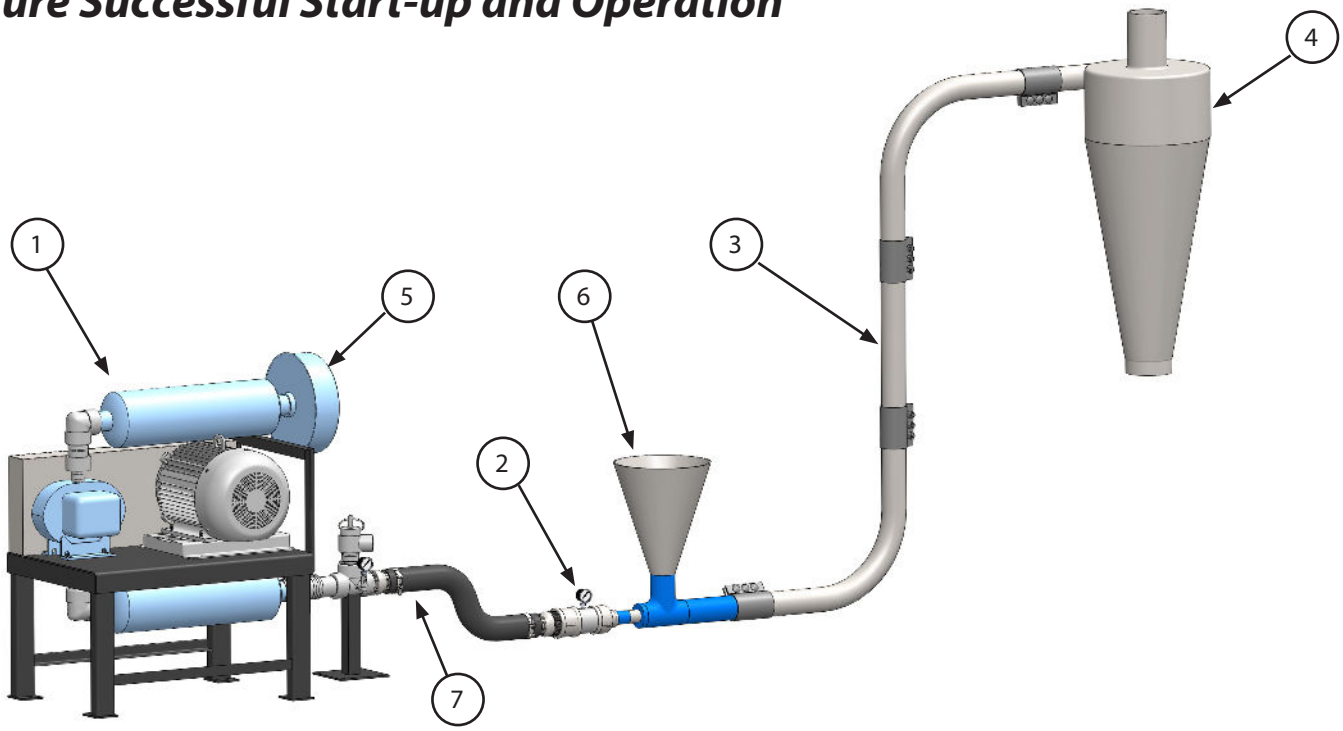
Installation & Operating Instructions:



Fox Solids Conveying Eductors

The Seven Most Important Steps When Installing Your Fox Eductor To Ensure Successful Start-up and Operation



1. **Refer to Blower Manual**
   Correct installation of the blower is vital for safe, reliable operation. Proper lubrication is vital for avoiding rapid blower failure. Note that blower failure due to inadequate lubrication is NOT covered by warranty.
2. **Install Pressure Gauge at the eductor**
   Make sure this gauge indicates that the motive supply pressure, as measured at the eductor, (not at the blower) matches the pressure on the Installation Drawing supplied by Fox. (If you don't have the unique installation drawing for this eductor, call Fox.) Make sure the air line between the blower and eductor is large enough for a total pressure drop below 1/4 psi (0.02 bar). A good rule of thumb is that it should be the same diameter as the conveying line.
3. **Be sure that the convey line piping is the correct size, and stays the same**
   Be sure that only wide radius bends are installed and that all straight sections are horizontal or vertical (no sloped lines.) Flex hose should be limited to less than 5 - 10 ft in length.

The Seven Most Important Steps When Installing Your Fox Eductor ...

4. **Check that the destination/receiver's dust collector, bin vent, or cyclone is large enough** to vent conveying air with no pressure build-up.
5. **Install the blower inlet filter** in a location where the air is relatively clean and is easy to reach. Be sure the filter has an easy-to-see indicator that tells maintenance when the filter element needs to be replaced.
6. **Hopper/Transition** must be designed to deliver material to the eductor without bridging. If material can't reach the eductor, the eductor cannot convey it away.
7. **Check for air leaks!** Before startup, check every connection in the air supply line/manifold for air leaks. This is the most common reason for inadequate air pressure at the eductor. Run the blower, and, using a brush and soapy water, brush every joint and look for bubbles.

The Five Most Common Errors to Avoid when Installing Your Eductor:

1. **Control Valves in line between blower and eductor:** Never install a control valve in the line between the blower and the eductor that limits or restricts the output of the blower. (Note: A Bleed Valve or Pressure Relief Valve, installed on a tee, is a good thing.)
2. **No flex line at the motive air connection:** Make sure the last few feet of air line connected to the motive air nozzle connection is flexible - see # 3 below.
3. **Nozzle fully inserted in eductor body:** Make sure the motive air nozzle is not pushed all the way into the eductor. The motive air piping should be installed to allow for position adjustment and the nozzle should be positioned initially with the tip at the center line of the product inlet.
4. **Dusty Environment/Dirty Air Filters:** If possible, install the blower in a relatively clean, cool area. If you must install the blower in a dusty area, then add an extension to the inlet piping so that the inlet filter can extend through a wall or a window to draw in cleaner air. Avoid locating inlet filter near the ceiling, where hot air accumulates.
5. **Using PVC Pipe for the Convey Line.** Do NOT use PVC or ABS pipe in the convey line. It will build up static electricity and give people a nasty shock! It could even cause an explosion. Use only metal pipe or tubing, and be sure they are adequately grounded.

Installing Your Fox Eductor Correctly - Technical Discussion

Install a Pressure Gauge near Eductor

It is essential that the supply pressure to the eductor matches that shown as the Motive Pressure on the Fox installation drawing supplied with the eductor. The motive nozzle has been machined to produce the appropriate air flow rate based on the specified motive air pressure.

- Be sure the gage has an appropriate range. (For example, a 100 psig gage cannot be used with 3 psig air.)
- Be sure the air piping between the blower and eductor is sized to produce less than 1/4 psi (0.02 bar) of pressure loss. Never choose this line size based on the eductor's motive air connection size.
- Warning: Failure to match blower output to specified pressure can pop pressure relief valves, trip thermal overload protectors, or burn out motors! The eductor's motive nozzle orifice is customized, and will act as a restrictor on your air supply.

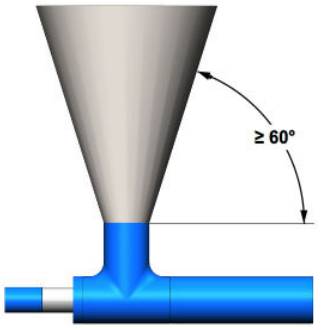
Ensure that downstream piping is never reduced in size from eductor discharge, and only wide radius bends are installed.

It is critical that the conveying line size is *the same size or slightly larger than* the discharge connection size of the eductor. For example, a 3" eductor should never discharge into 2-1/2" pipe. Be sure there are no nozzles or restrictions in downstream piping (for example, when conveying through refractory into a boiler.) The pressure created in the downstream convey line is the most critical factor in a successful eductor application. This must be reduced whenever possible. Be sure that all elbows are medium or long-radius, pipe joints are properly aligned and that any valves or diverters are wide open. Call factory if blind tees or "vortice style" bends are used and were not included in design conditions.

Check that dust collection, bin vent, or cyclone is adequately sized. Unless explicitly stated on your eductor installation drawing, it is assumed that there is zero pressure at the discharge end of the convey line.

Blower Inlet filter must be clean. Dirty blower inlet filters restrict blower air flow, reduce system performance, can cause line blockages and can even cause premature blower failure. Filter maintenance is vital. A vacuum gauge or filter indicator gauge is very useful for indicating condition of the filter element.

Hopper/Transition must be designed to deliver material to the eductor without bridging. If material cannot reach the eductor, the eductor cannot convey it away. Be sure your hopper is well suited to your particulate's characteristics. Free-flowing materials can be *flood-fed* into the eductor without 'clogging'. The idea that eductors must be trickle-feed is wrong.



Bridging in the hopper must be avoided. Flow through the hopper must be consistent and reliable. To ensure flow, even with a free flowing material, it is good practice to design the hopper with not less than a 60° cone angle from horizontal. 70° or 75° is even better. Hopper outlet size is critical too. A handful of products cannot be flood-fed into Fox eductors because they bridge in even well-designed hoppers. These include irregular shapes (certain flakes, fibers, metal chips, some plastic regrind) and highly cohesive powders like TiO_2. These materials must be *meter-fed,* usually with a screw feeder, vibratory feeder, or other device.

Operating Your Fox Eductor Correctly - Technical Discussion

Controlling Rate

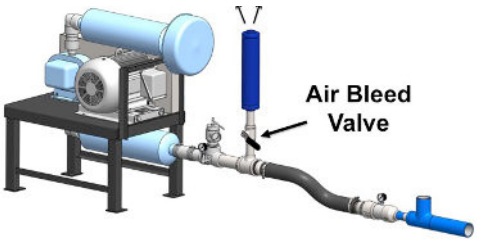
Fox eductors cannot be used to accurately control or meter solids flow rates. Do not attempt to regulate or meter solids convey rate by adjusting motive air flow rate or pressure. Decreasing specified motive pressure from that specified by Fox may cause your convey lines to plug.

Temperature Rise

All blowers produce a ΔT, or temperature rise, anywhere from 20°F to as much as 150°F (11-83°C), depending on the blower type and pressure. This may be a concern when conveying foods, plastics, and other solids. Note, however, that because the contact time between the hot air and solids is so short (for example, 1.5 seconds in a 100 ft convey line) heat-transfer may be so limited that this may not be a problem even with temperature-sensitive materials. However, if hot convey air is a problem with your material, Fox can provide a cooler (air or water-driven) that will reduce the convey air temperature to that required.

Conveying Velocity

Fox eductor systems are typically designed to convey materials at between 3500 - 4500 ft/min (17-23 m/s), although this can be slower for lighter or fluffier particulates and faster for rounder, denser, or cohesive materials. High transport velocity is the major source of both wear (with abrasive materials) and product damage (with fragile materials.) Fox can supply Bleed Valve Kits that can be used by the operator to release/divert/bleed air from the eductor, in order to reduce transport velocity and minimize product breakage or bend wear rates. Blower speed and output can also be controlled with Variable Frequency Drives, and (where applicable), drive sheave changes.



Control Sequences

If you are using an eductor to empty a bin or hopper, or deliver a weighed batch into a process, there are a few steps to keep in mind. Avoid starting and stopping the blower with the eductor and convey lines full of product. Purge convey lines before the blower is shut off.

If a slide gate valve is installed above the eductor, the control sequence should be as follows:

Start up

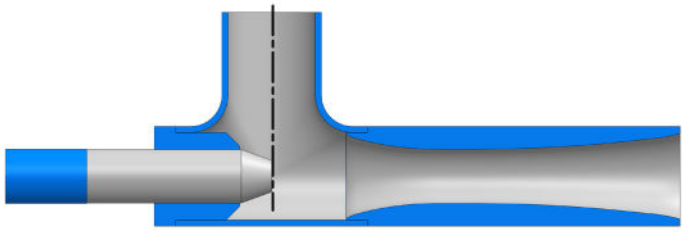
a) Turn on blower. Wait a few seconds
b) Open slide gate valve. Convey product

Shut down

a) Close slide gate valve.
b) Allow blower to run another 30 sec. to purge convey line
c) Turn off blower

Check Valves

A check valve should normally be installed between blower and eductor, in order to prevent particulates from leaking back into the blower. It is disastrous for solids to get into the blower. If in doubt, call Fox.



Motive Air Nozzle Position

Fox venturi eductors include an important special feature for eductors used in pneumatic conveying applications: Adjustable nozzle position. For most applications, nozzle position is not a critical factor and the nozzle should be left where it is set at the factory. Adjustments may have some impact on capacity, but in general, if the nozzle tip is roughly at the center line of the product inlet, there is not much to be gained by further adjustment.

Nozzle position is adjustable for two primary reasons:

a) When conveying irregularly shaped or large particles, the nozzle can be withdrawn to enable these large particulates to pass. Similarly, when highly abrasive particles are conveyed, the nozzle can be withdrawn to be less susceptible to wear on the nozzle tip. In both cases, nozzle position is not ideal but the advantages of a slightly withdrawn nozzle outweigh the slightly degraded eductor efficiency from a slightly backed-out nozzle.
b) When conveying long distances, the nozzle tip must be inserted deeper into the eductor for better/more stable performance.

Do not let your installers adjust the nozzle position just to make it easier to connect to rigid air lines. The last few feet of air line to the eductor should be flexible, to permit position adjustments.

Detecting a Blocked Convey Line

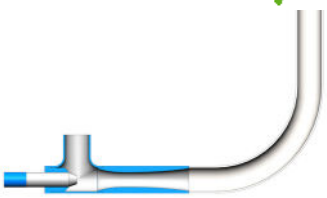
It is common to want to instrument a system in an attempt to detect a clogged convey line. Note that the blower output pressure measured upstream of the eductor will never change whether the eductor is or is not flowing solids, or if the downstream line is or is not clogged. (This differs radically from airlock-fed systems.) If a blockage should occur in the downstream conveying line *and* the eductor suction connection is open to atmosphere, the conveying air (and product) will simply blow out through the suction port. A pressure sensor installed in the conveying line will probably not operate reliably due to blocking of the connection. In any case, it is hard to establish a signal that can reliably provide meaningful information; (the average pressure in a normally operating line is only slightly lower than in a blocked line.) The best place to detect a clog is with a level detector on the product inlet of the eductor.

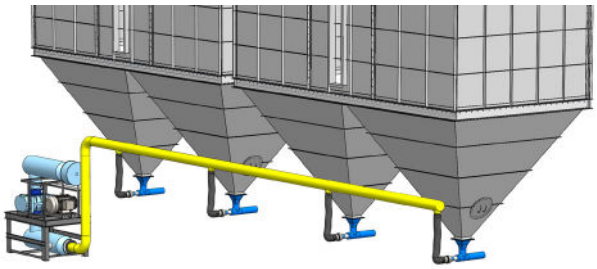
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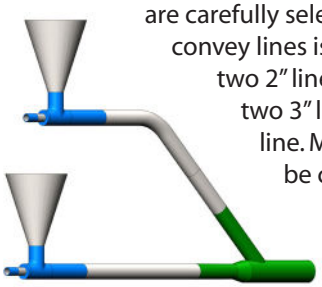
It is perfectly OK to install an elbow at the discharge of the eductor, without a length of straight pipe. This differs from accepted practice with airlocks.

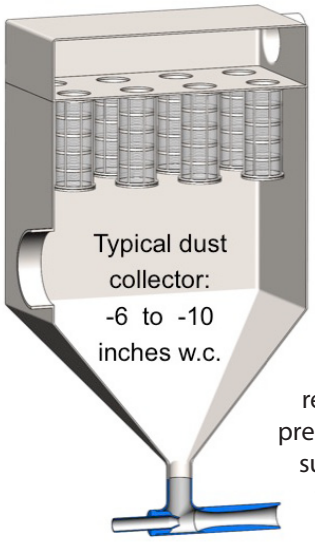




Many Fox venturi eductors can be driven by one blower. There are Fox systems with as many as thirty eductors operating simultaneously with one blower. This requires careful sizing of the air supply manifold, careful sizing of discharge lines, and a clear definition of operating modes.

The discharge lines of two eductors can be merged into a common convey line as long as the line sizes are carefully selected so that total area in the convey lines is kept constant. For example, two 2" lines must be merged to a 3" line; two 3" lines must be merged to a 4" line. Moreover, the 'Y' fitting must be carefully designed. Fox can supply these custom-built fittings.

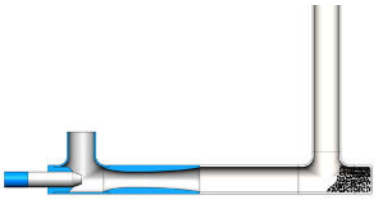




Eductors can overcome some negative pressure (vacuum) in the hopper above them - which is typical when conveying from dust collectors, baghouses, etc. This should have been accounted for in the design and should not be a problem. Having negative pressure above the eductor means that the eductor will require a higher motive air pressure, in order to generate sufficient vacuum to counteract the opposing negative pressure and convey material away at the required rate.

But don't do this!

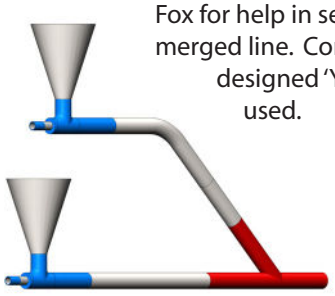
Never install a "Blind Tee" immediately downstream of an eductor. Although carefully designed Fox eductor systems can work with blind tees as bends, they should be avoided and replaced with wide radius bends. Careful attention to conveying velocity should be the primary approach to controlling bend wear.



Do not install more than 5 - 10 ft of flexible hose on the discharge of the eductor. Flex hose creates more pressure loss than rigid pipe and will reduce conveying capacity. If hose must be used, keep it running as straight - and as short as possible.



NEVER merge two eductors into one common line without increasing line size appropriately. Contact Fox for help in selecting the right ID for the merged line. Contact Fox for the carefully designed 'Y' fitting that should be used.



Never install sloping lines! It may seem more logical to reduce the numbers of bends in a system, and use less piping by routing it on a slope, but this actually reduces the conveying system's efficiency by increasing the wall friction. This truly is not a myth!

USE ONLY HORIZONTAL and VERTICAL pipe runs.



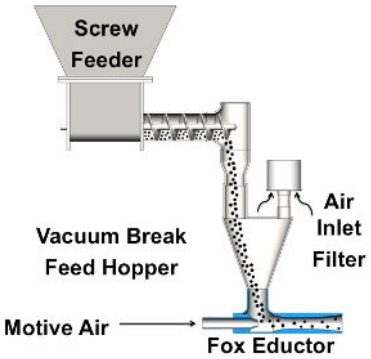
Troubleshooting Guide

Problem	Possible Cause	Possible Solutions
System conveys at a rate below specified capacity. *Common mistake to avoid: Do not assume the product inlet of the eductor suction port is "too small." The problem is probably with the upstream or downstream system pressure, not the physical size of the eductor.*	**Most Common Source of Problem: Insufficient supply, or motive, air pressure**	*1) Install accurate, appropriate range pressure gage at nozzle of eductor. 2) Check that motive air pressure matches that stated on Fox installation drawing supplied with eductor. If not, check: (a) blower inlet filter is clean, (b) there are no leaks in line from blower, (c) air line between blower and eductor is properly sized - for less than 1/4 psi loss.*
	Discharge pressure higher than expected.	*1) Check that venting of receiving bin/silo/destination is working; be sure to check that filter bags/media are clean. 2) Check that there are no unexpected reductions, restrictions, nozzles, or undersized valves in downstream convey line. 3) Check that installed bends are of the type described to Fox. Are 'vortice' style bends, or 'blind tees' installed?*
	Convey line or eductor partially blocked by build-up/scale.	*Check eductor & line for blockages and build-up.*
	Bridging above eductor interferes with material feed.	*Call Fox Valve for advice.*
	Convey distance and/or number of elbows greater than specified	*Call Fox.*
	Nozzle position not optimized	*Reposition nozzle, starting at center point of suction inlet.*
Relief valve on blower is popping open	**Most Common Source of Problem:** *Air flow from blower is higher than it should be.*	*1) Slow down p-d blower speed; by either new/revised v-belt drive components or by installing a VFD. 2) Bleed air off excess air*
	Pressure relief valve is set at too low a pressure.	*Reset relief valve to open at a pressure higher than the specified motive pressure; but check with blower supplier first!*
Air puffing up through suction	**Most Common Source of Problem:** *Discharge pressure higher than expected OR Insufficient motive pressure.*	*Check convey line exit pressure. If excessive, take corrective action, e.g. clean filter bags. Check blower inlet filter, air-blower line.*
	Nozzle has been withdrawn too far out of eductor.	*Adjust nozzle position (push farther into eductor) until optimum position found.*
Excessive Product Damage, or Excessive Elbow Wear	**Most Common Source of Problem:** *High air velocity.*	*If degradation was mentioned during the quotation phase, if Fox supplied the blower then Fox probably supplied a Bleed Valve Kit. Use the Bleed valve to divert some air , thereby lowering air velocity in the downstream line and causing less product damage and degradation.*
	Oversized eductor running with so little product that excess air is entrained, causing high convey velocities.	*Call Fox*

Installing Your Fox Eductor Beneath :

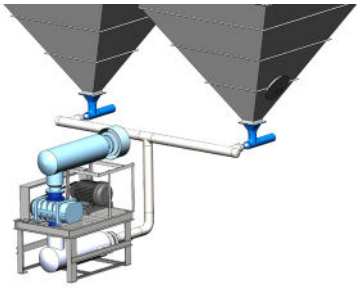
Screw Feeders

Screw feeders must discharge into either an open hopper or an enclosed, vented hopper or open drop-leg. The eductor cannot be allowed to pull a vacuum on the feeder, which will disrupt dosing accuracy.



Dust Collectors, <u>without</u> Screw Conveyors

Eductors should have no problem overcoming the minor negative pressure in most dust collectors, ESPs or cyclones. No valves or rotary airlocks are needed between the eductor and dust collector (except for usual maintenance purposes). Do not use the dust collector hopper as storage. Most dust collectors deliver surges of material (during the cleaning cycle). If the dust is free flowing, these surges may safely accumulate in the dust collector hopper until the eductor conveys them away. However, you may wish to have your eductor sized for the instantaneous surge rate, to minimize the time the dust remains stagnant (and potential for bridging increases.)



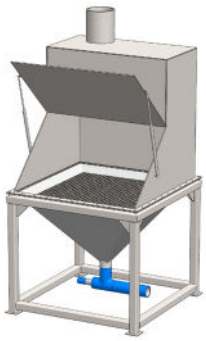
If your Fox equipment features an access door with screen, it is to allow quick access to the inlet port for inspection/removal of foreign objects.

Dust Collectors, <u>with</u> Screw Conveyors

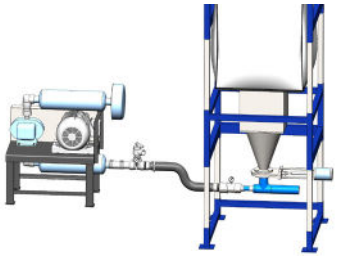
Screw conveyors connected to a bank of dust collectors often deliver very large surges of dust. Make sure your eductor has been specified and designed to meet this high surge rate, not the time-averaged rate. There may be ways to reduce the volume of the surges by slowing down the screw conveyor and increasing the frequency of cleaning cycles.

Bag Dump Station

Start up the blower before dumping product into the bag dump hopper. The eductor system should only be shutdown after all product has been emptied, and the convey line has been purged.
The eductor will not control or prevent dusting from the bag dump station.
If the product being dumped is dusty or generates dust then the bag dump station must be vented to a localized vent filter, or to a central dust collection system.



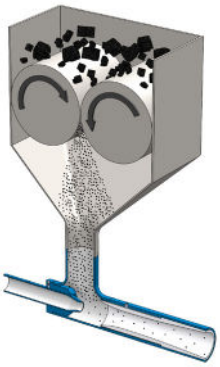
Bulk Bag Unloaders/ Silos



For free flowing materials, the silo or bulk bag can be directly connected to the eductor via a well designed transition. For poor flowing materials, flow aids and/or a metering device will be needed to feed the eductor. A gate valve should be installed above the eductor inlet connection, for use at system start-up and shutdown. The gate valve prevents product from 'flooding' into the eductor and plugging the convey line when the blower is turned off. Establish air flow first, before opening the valve, and also purge the line after each valve closing. When conveying highly fluidizable products from a tall silo, i.e. products which become fluid when aerated, Fox recommends a suitable metering device to regulate the flow to the eductor.

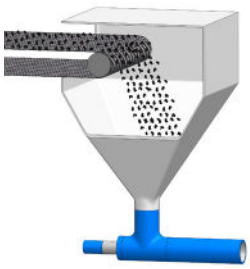
Grinders/Mills

With some grinders or mills, a significant amount of air passes through the mill and must also be drawn into the venturi eductor. Make sure you have specified an eductor that handles not only the solids rate, but also the large volume of air that passes through the grinder.



Belt Feeders, Vibratory Feeders

A simple funnel is all that is required. However, an open funnel may be noisy, so partial enclosure will reduce noise.



Rev 10-16

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