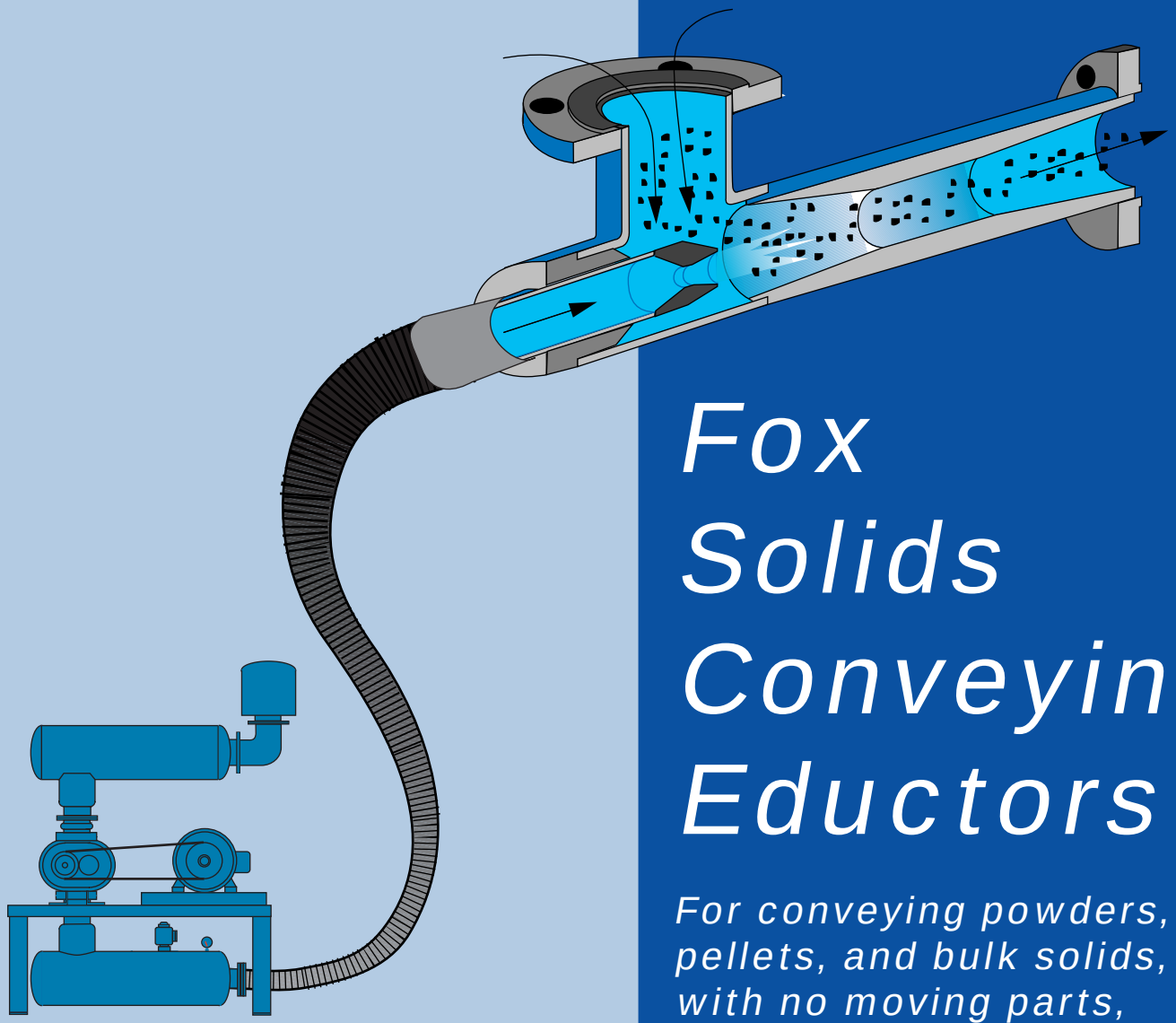

Fox Solids Conveying Eductors

For conveying powders, pellets, and bulk solids, with no moving parts, since 1963.

FOX VALVE
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Bulletin 301C

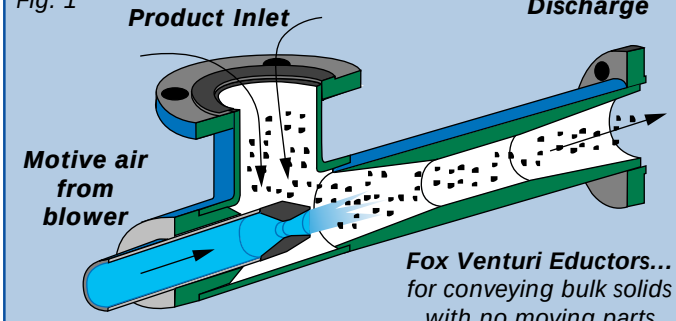
Fox Venturi Eductors for Conveying Solids with No Moving Parts

- **No Maintenance**
- **No Blow-Back**
- **Minimal Product Degradation**

Fox Venturi Eductors - What are they?

Fox Venturi Eductors convert the output of a blower into suction that can be used to entrain and feed powders, pellets, and bulk solids into a pneumatic conveying system. Because they have no moving parts, they can operate almost entirely maintenance-free.

Fig. 1



Fox Venturi Eductors... *for conveying bulk solids with no moving parts*

The eductor acts to compress the air/solids mixture to a pressure adequate to overcome losses in the downstream convey line. The eductor has three connections:

- *Motive Air*
- *Suction or Product Inlet*
- *Discharge*

How are they used in pneumatic conveying systems?

Fox Venturi Eductors are used to feed bulk solids, such as powders, pellets, flakes, and particulates, into positive, dilute-phase conveying systems. They are commonly used in place of rotary valves where airlocks simply cannot perform adequately.

Fox eductors are attractive to install beneath other solids processing equipment because, by creating suction at the product inlet, they enable dust-free material conveying systems. They are commonly installed beneath:

- *Baghouses/Dust Collectors*
- *Volumetric and Loss-in-Weight Screw Feeders*
- *Screener/Classifier Outlets*
- *Mixers, Grinders, and Mills*
- *Bins, Silos, and Bulk-bag Unloaders*

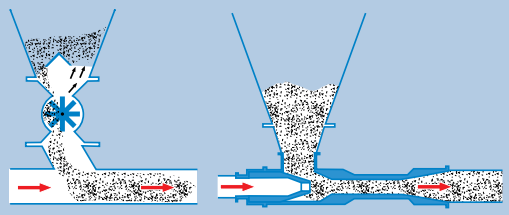
Who uses them?

Fox Venturi Eductors are used in industries as diverse as plastics, power, chemicals, food & dairy, foundries, mining, bakeries, smelting— anywhere that powders or pelletized products are transported. Fox has made installations in hundreds of plants, in dozens of countries, since 1963. Request our database of 2000+ existing installations.

Why are eductors used in pneumatic conveying systems?

- *Fox Venturi Eductors have No Moving Parts – allowing for maintenance-free feeding of bulk solids. In applications involving fine, abrasive, or irregularly-shaped products, this is an enormous advantage. Replacement of existing rotary airlocks with venturi eductors makes for simpler, more reliable conveying systems. Designing with eductors from the beginning ensures the most reliable product feeding available.*

Fig. 2



Eliminating the rotary airlock, left, with a venturi eductor, right, permits product feed without moving parts - maintenance-free conveying.

- *No Blowback - All rotary airlocks have blowback. If the product conveyed is fine or abrasive, blowback can cause extreme wear problems. Even with free–flowing products, blowback can be a problem, causing bridging and housekeeping problems, or even an explosion hazard. When installed beneath baghouses, screw conveyors, or dust collectors, airlocks can be a major source of fugitive dust emissions, which are eliminated after a retrofit to Fox eductors.*
- *No mechanical shearing - Eductors minimize the shearing, smearing or degradation of product common with rotary airlocks. And, of course, safety is simply not a concern with Fox eductors.*

How are they designed? How are they tested? Are they guaranteed to work?

Fox's eductor designs have been exhaustively tested with different materials, line lengths, motive air flows and pressures - yielding the most complete set of performance data ever accumulated. This data has been transformed into computer algorithms which allow our engineers to rapidly and precisely predict eductor performance with almost any product in your system. Moreover, we have over thirty years of hands-on industrial experience and feedback to draw upon. This enables Fox to performance guarantee every quotation and every eductor that leaves our factory. New or challenging materials can be tested, if necessary, in our in-house conveying test rig. Interested parties are always welcome to visit and witness tests.

The Ten Questions Most Commonly Asked About Fox Venturi Eductors:

1) Don't they need evenly metered feed or they'll clog? Wouldn't a full 'head' of product 'overfeed' the eductor?

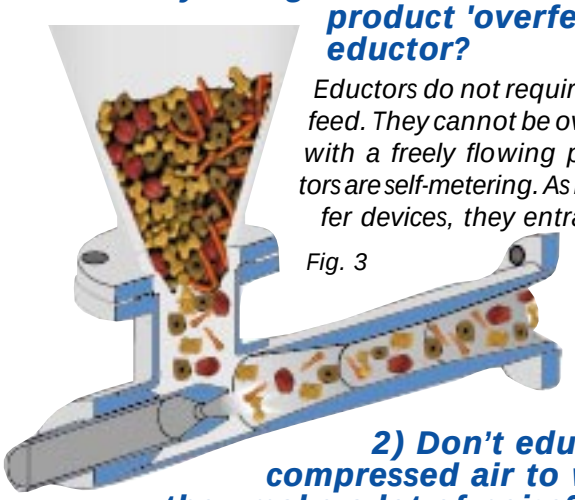


Fig. 3

Eductors do not require evenly metered feed. They cannot be overfed or clogged with a freely flowing particulate. Eductors are self-metering. As momentum transfer devices, they entrain only as much product as they can accelerate and convey through the discharge line.

2) Don't eductors need compressed air to work? Don't they make a lot of noise?

People often confuse conveying eductors, which are quiet and use low pressure air, with steam ejectors, which can whistle loudly. Solids eductors flood-fed with product or fed from closed bins are very quiet, certainly below 85 dB.

3) What conveying velocity does Fox design around? What controls velocity?

Fox designs its eductors to convey product at about 3500 to 4500 ft/min. This is high enough to convey most bulk materials with plenty of margin (fluidization velocity is not a direct function of bulk density) and minimizes line losses and degradation. (See technical discussion in Fox Bulletin 350 for conveying fragile products at lower speeds to reduce degradation.) The nozzle orifice size– carefully chosen – precisely regulates air flow in the line.

4) What if the blower fails and the eductor is conveying product? Can it simply restart?

Almost always. Many users install a slide gate valve between the hopper and eductor so the convey line can be purged, but it is not always necessary. Unless there's a long vertical rise (50+ ft), the eductor will start right up.

5) We tried eductors before. They didn't work. What's different?

Many companies have, at some point, built a homemade venturi. They welded together some tubing, some reducers, some piping and some sheet metal and made the best venturi they'd ever seen. Usually, it didn't work and they've never tried eductors again. Fox eductors have been installed in over a thousand plants, handling hundreds of products in dozens of industries, in over twenty countries, since 1963.

6) Why don't the big system designers install eductors in their conveying systems if they work so well?

Simple answer - They don't make eductors and they don't like to sell products that they don't make. They manufacture rotary airlocks, and want to sell rotary airlocks, even if inappropriate for a given system. Reducing maintenance in <u>your</u> plant is not <u>their</u> priority.

7) Don't eductors need to be evenly fed or they'll clog? Wouldn't a surge 'overfeed' the eductor?

(This question is usually asked twice — with slight variations). It hasn't happened yet. A surge simply accumulates at the product inlet as the eductor continues to convey product at it's maximum rated capacity.

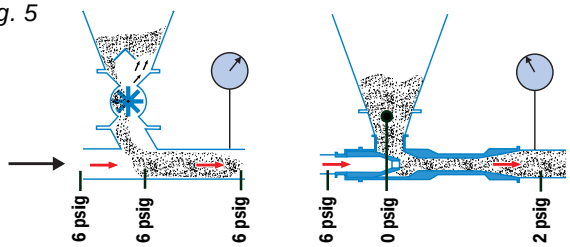
8) How does an eductor meter or control the feed rate?

It does not. Eductors cannot be used to regulate convey rates. They have a maximum capacity or rating for a given product in a given system (i.e. a 3" eductor will convey 3 t/h) but do not control rates.

A feeder doses minors to a sanitary Fox eductor. *Fig. 4*

9) Why do eductors require more energy than airlocks?

Fig. 5



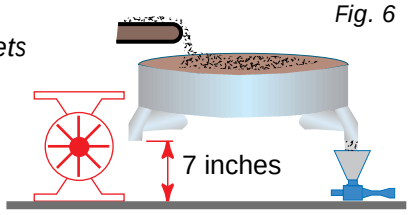
Comparison of the pressure gradient in a convey line beneath an airlock and a venturi eductor.

Eductors perform a radical manipulation of the pressure in your convey line, enabling product to be fed into a region at 0 psig with no blowback. This results in some energy loss but enables improved solids handling. See above illustration comparing an airlock and an eductor.

10) How much headroom do they need?

Fox eductors can be installed beneath outlets only 7" above the ground, enabling use handling 'overs' and 'unders' from screeners.

Fig. 6



How to Use a Venturi Eductor in a Conveying System:

Designing New Systems with Venturi Eductors:

As with any conveying system, the three basic questions are: What product? How much? How far? Send us a completed data sheet and Fox engineers will prepare a ***Performance-Guaranteed*** *quotation on an eductor or a complete conveying system. The quotation will include all relevant operating data.*

Fox Venturi Eductors can convey most dry bulk solids, but the following conditions must be met:

- *Solids must be gravity fed into the eductor.*
- *Downstream piping can never be reduced.*
- *Eductors can never be used in series.*
- *All elbows should be swept; medium to long radius preferred. Flex hose lengths must be short.*
- *An appropriately sized air/solids separation system must be installed at the discharge of the conveying line (bin vent, cyclone or dust collector, etc.)*
- *Conveying line length must be below 400 ft.*

Multiple Eductors Driven by One Blower: *Eductor systems often use one blower to drive many eductors, making for surprisingly simple systems when handling material from multiple outlets, as is common with dust collectors. (See Fig.10)*

Retrofitting Existing Equipment

Retrofitting existing systems with Fox eductors can result in very significant improvements:

- ***Eliminate airlock wear***
- ***Reduce product damage***
- ***Avoid dust emissions and leakage***
- ***Facilitate clean-outs if cross-contamination is critical***
- ***Reclaim otherwise discarded product***

Fig. 9

Eductors can be installed under just about any piece of equipment that discharges a bulk solid, such as feeders, dust collectors, screeners, bulk bag unloaders, mixers, silos, etc. Fox eductors can be supplied with customized, integral inlet transitions that can mate to any outlet, as shown in Figure 9.

Fox publishes over fifty ***Case Studies*** *describing actual installations in dozens of different industries. For a partial listing, see page 8. A complete listing is available upon request or from our website. (www.foxvalve.com)*

Retrofitting Dust Collectors and Baghouses with Fox Eductors

Eductors are frequently installed beneath dust collectors, often replacing screw conveyors which collect dust from multiple outlets. Screw conveyors are primary sources of fugitive dust, often need repair, and require that all modules of a baghouse are shut down if one outlet is clogged or needs repair. Multiple eductors enable all outlets to operate while one is accessed for maintenance.

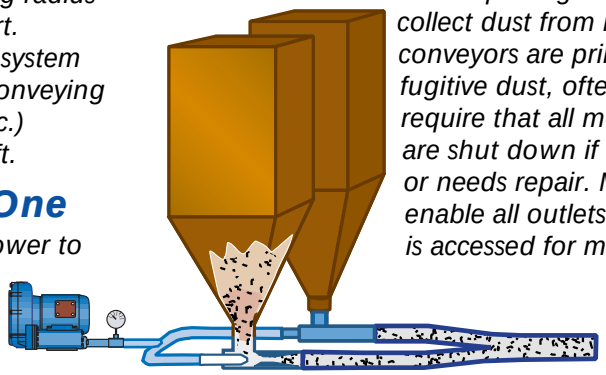
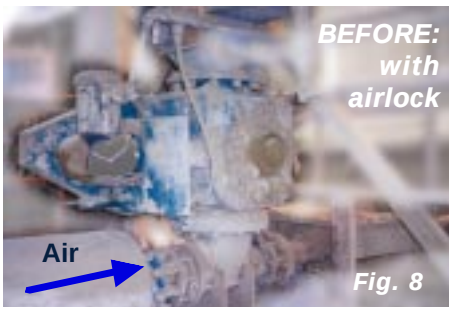


Fig. 10

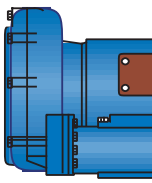
Replacing Rotary Airlocks with Fox Eductors

Fox Eductors are often used to replace rotary airlocks for pneumatic transport of solids, resulting in systems with much less complication, no maintenance, no blowback, no seals or bearings, no safety hazard, and one less motor starter to install.

Replacing an airlock in an existing convey line with a Fox eductor may require changes to the blower or convey line. Fox engineers will provide all necessary sizing information upon receiving a completed Application Data Sheet.



Engineering a venturi eductor into a system at an early design stage is far easier than retrofitting existing equipment. Contact Fox Valve early in your design efforts to see how maintenance-free conveying can be engineered into your process.



Rotron Blower

What Can Fox Provide With an eductor?

Blowers

All eductors require a source of conveying air, which is supplied by a blower. Every year, Fox supplies hundreds of Eductor/Blower subsystems, providing a perfectly matched blower to the required eductor. (For more info on these sub-systems, request Bulletin 302) Any type, or make of blower can be provided but most fall into the following two categories:

- ***Rotron blowers*** *– output to 8 psig.*
- ***Positive Displacement blowers*** *– to 15 psig.*

Conveying Systems and Skid-Mounted Packages

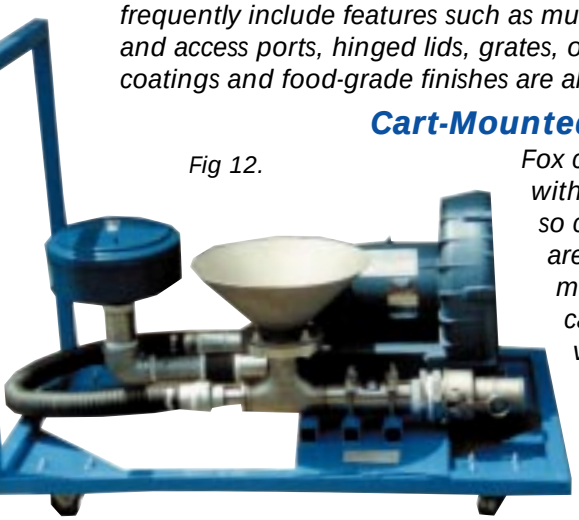
Fox can provide most additional equipment needed to integrate Fox eductors into your plant or existing system.

Hoppers, Bins, & Transitions

Fox can provide custom-fabricated hoppers and transitions. Design options are virtually unlimited and frequently include features such as multiple inlets, vent and access ports, hinged lids, grates, or screens. Special coatings and food-grade finishes are also available.

Cart-Mounted Systems

Fig 12.

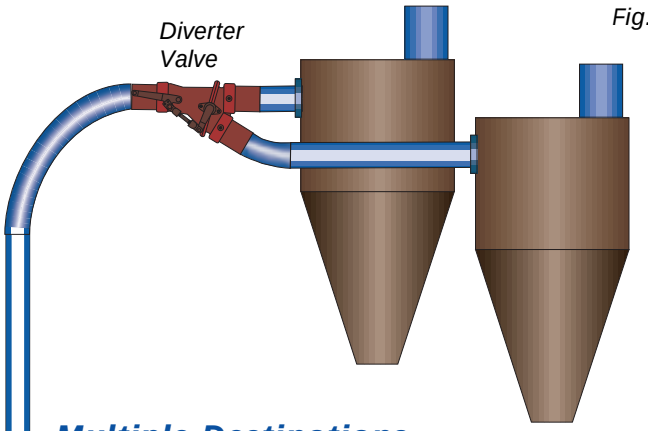


Fox conveying systems with Rotron blowers are so compact that they are often mounted on mobile carts so they can be moved to various processes within a plant.

- ***Valves****: All types: slide gates, diverters, etc.*
- ***Feeders*** *- Screw, L--I–W, Vibratory, Weigh Belt, etc.*
- ***Receivers, Cyclones, Dust Collectors*** *- It is very important to use a correctly specified air/solids separator for your eductor system, which Fox can provide.*
- ***Convey line*** *- As part of a system, Fox will supply many types of convey line, complete with bends and couplings.*
- ***Bulk Bag Unloaders, Bag Dump Stations etc.*** *- Can be supplied.*

Inlet Filter/Silencer, Relief Valve — *Fig. 13* — *Fox Eductor* — *Wide Radius Bend*

Fig. 14



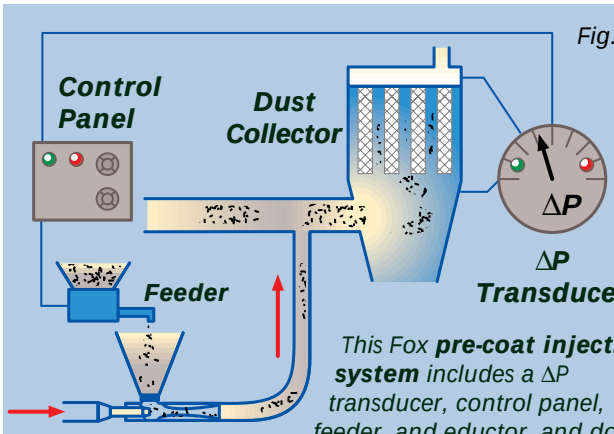
Multiple Destinations

Fox eductors can, of course, be used to convey product to any one of many destinations. Fox often supplies diverter valves to direct solids flow to the silo, mixer, weigh bin, or receiver where product is needed.

Controls

Fox eductor conveying systems often include control panels incorporating PLCs, which can be used to control system operation as required - for example, responding to signals from level detectors to stop or start, or activate a diverter valve. Fox systems can include feeders, blowers (with motor starters), slide gates, etc. A typical Fox additive injection system with controls is shown below:

Fig. 15



*This Fox **pre-coat injection system** includes a ΔP transducer, control panel, feeder, and eductor, and doses filter-cake or precoat into the dust collector as required to maintain a minimum ΔP across the filter media.*

Hundreds of compact, quiet, Fox systems operate in packing rooms, reclaiming good product from damaged packaging.

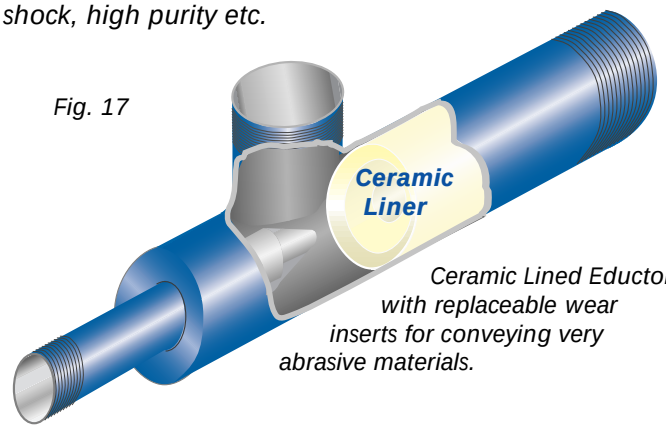
Fig. 16

Eductors for Handling Abrasive, Fragile, and Food Products

Fox Ceramic-Lined Venturi Eductors

Highly abrasive products can cause excessive rotary valve wear that can shut down operations. Fox ceramic-lined eductors should be used to convey erosive products when long service life and reliability are paramount. The standard ceramic liners are made from alumina — second only in hardness to diamond. Numerous other materials are available to handle requirements such as thermal shock, high purity etc.

Fig. 17



Ceramic Lined Eductor with replaceable wear inserts for conveying very abrasive materials.

Fox Sanitary Venturi Eductors

In applications that demand food grade hardware, Fox offers a complete line of Sanitary Eductors, designed for rapid disassembly in Clean-In-Place (CIP) systems. These eductors are USDA–approved, are built in 304 or 316 ss, and have highly polished internals with all welds ground and polished. Fox has extensive experience in conveying fragile food products ***without degradation****. Ask for our Bulletin 350.*

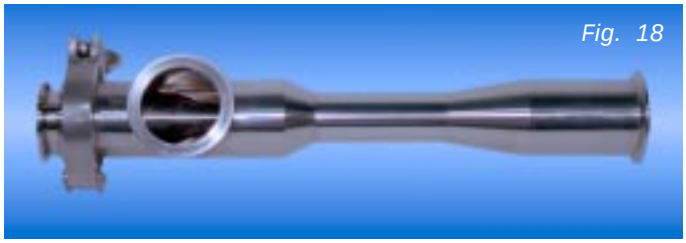


Fig. 18

Fox Eductors for Rotary Valve Venting

Fox Rotary Valve Venting Eductors provide reliable and positive venting of problematic airlocks, conveying the product-laden blow-back to one of two destinations, either:

1. Injecting directly back into the conveying line, or
2. Conveying back into the hopper, silo, bin above.

Ask for Bulletin 360

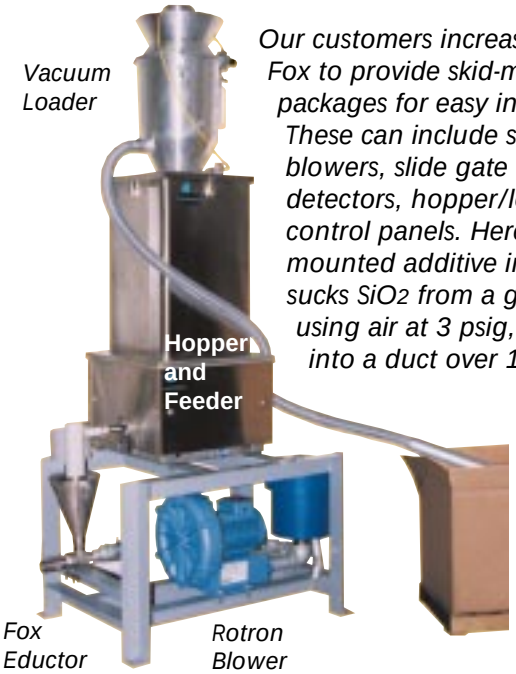
Additive Injection Systems using Fox Eductors and Rotron Blowers

Fox Valve provides complete additive injection packages for a broad range of industrial applications. Often using small blowers running at 3 psig, a Fox additive system can be located more than one hundred feet away from the receiving mixer, duct, cupola or dust collector. Fig 15 shows a typical pre-coat system. Similar systems are used for flue gas conditioning (power industry), acid neutralization of vapors (incinerators), and minor ingredient injection (food processing).

Fox Skid-Mounted Assemblies

Our customers increasingly rely on Fox to provide skid-mounted packages for easy installation. These can include screw feeders, blowers, slide gate valves, level detectors, hopper/loaders and control panels. Here, a skid-mounted additive injection system sucks SiO_2 from a gaylord and, using air at 3 psig, will inject it into a duct over 100 feet away.

Fig. 19



Eductors with Dump Ports, Grates, and Access Doors

Fox eductors installed under dust collectors usually have to convey only very low average rates of dust, but also encounter occasional lumps and foreign objects. In this common situation, Fox eductors are often supplied with clean-out, or dump ports, as shown below, to enable easy access to eductor internals. Moreover, the inlet transition supplied with the eductor often includes an internal grate and access door.

Fig. 20

A ceramic-lined Fox eductor, with a clean-out port, conveys foundry dust from a dust collector directly into a container for disposal at landfill.

Fox Solids Pick-Up Eductors

Fox pick-up eductors can be used in some applications to lift pellets and bulk materials up out of gaylords, barrels, and drums. Pick-up Eductors can only be driven with compressed air.

Optional Features to Enhance Eductor Performance in YOUR System

Fox understands that users often require that standard eductors be modified with additional features that will make them ideal performers in your application. Below is a partial list of available options and features:

- ***Customized** suction inlet or transition - Built to mate eductor to any size and shape of outlet*
- ***Coatings** - Ceramic, Anti-stick*
- ***Purge ports** - To help eliminate cross-contamination*
- ***Electro-polishing** - For extremely high internal finish to inhibit buildup with sticky, hygroscopic materials, and for ease of cleaning*
- ***All-welded assembly** - For high temperature products, high pressures.*
- ***Special materials** - For corrosion resistance, high temperatures, etc.*

Complete Installation Instructions

Fox has detailed installation instructions that address most operational questions about how a Fox venturi eductor should be installed in a system, including discussion of filter/receiver sizing, blower location, feed hopper design, etc. Two versions are available:

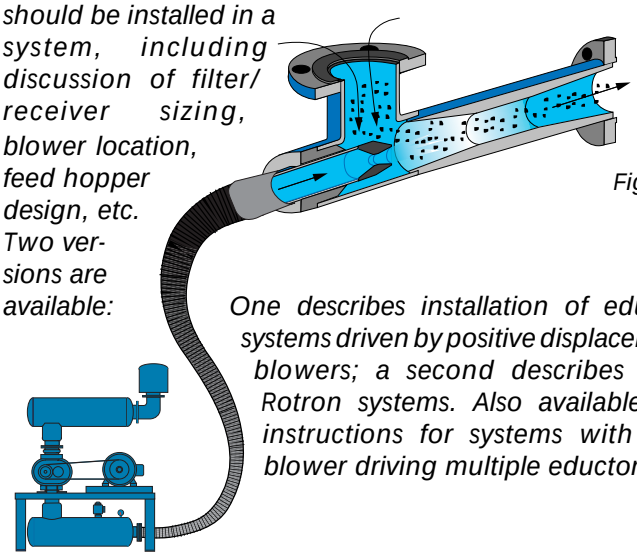
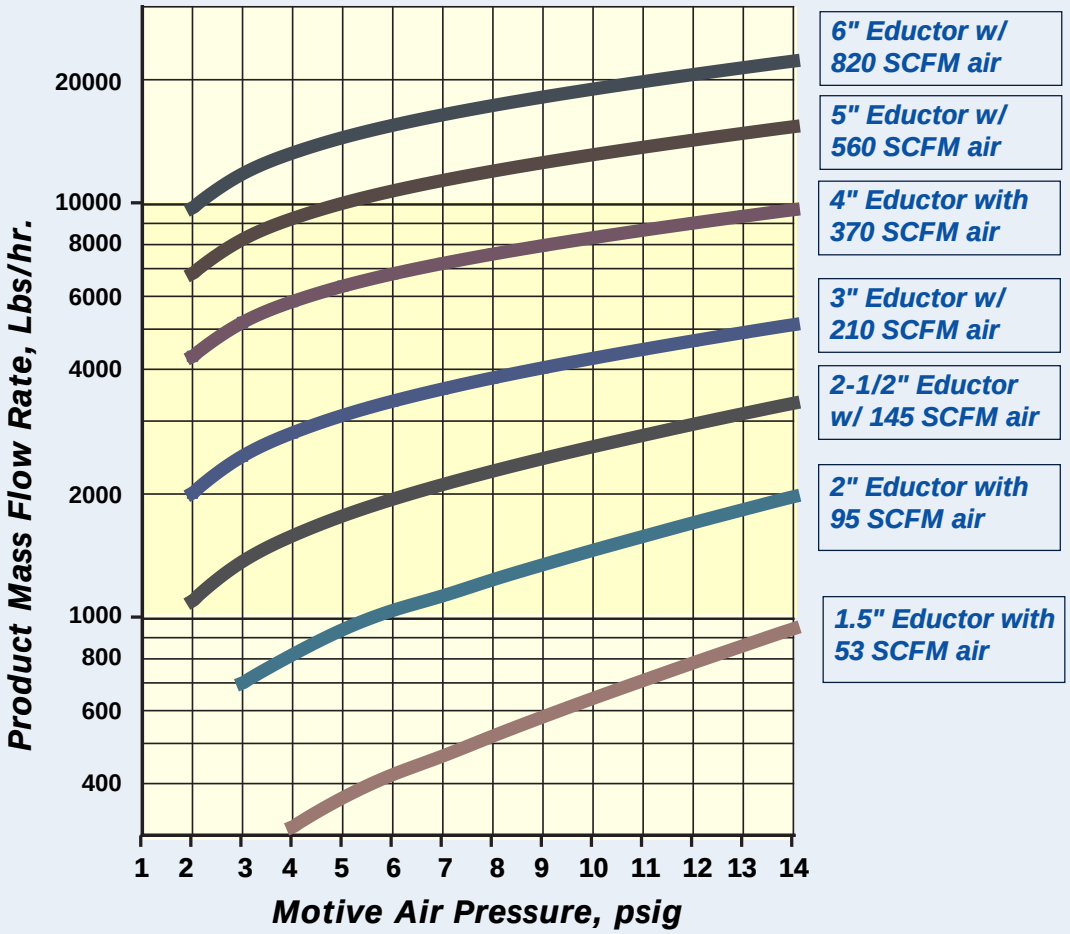


Fig. 21

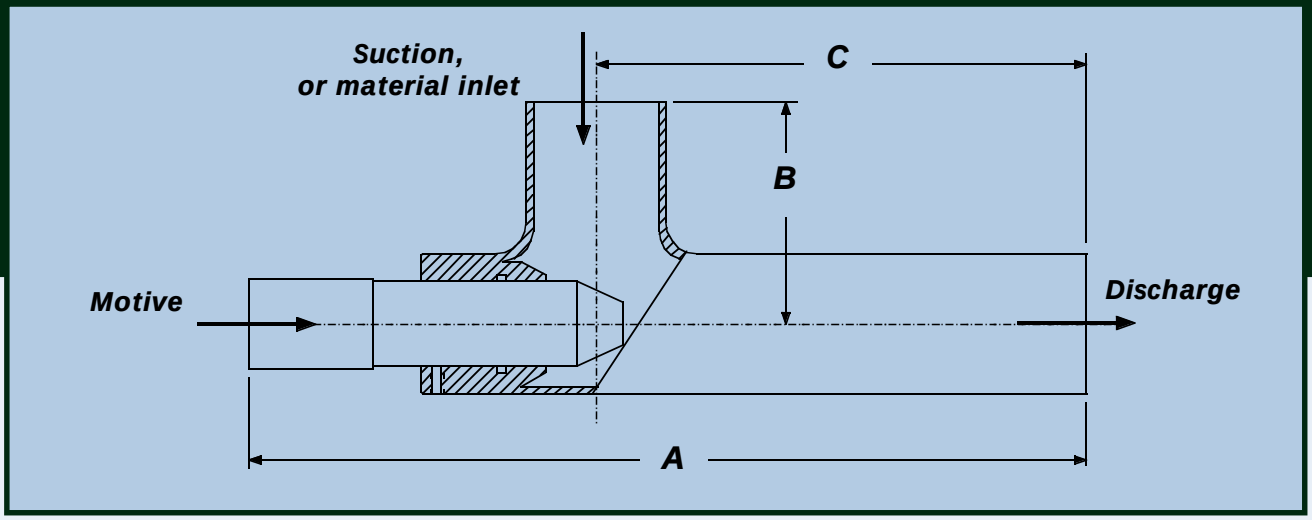
One describes installation of eductor systems driven by positive displacement blowers; a second describes Fox/Rotron systems. Also available are instructions for systems with one blower driving multiple eductors.

Estimating Capacity and Air Use of Fox Conveying Eductors



Above are curves showing the approximate capacity of standard Fox eductors in a simple conveying application: Pellets or granular product conveyed 150 feet, with 3 wide radius elbows. These curves can be used to estimate approximate capacity for products ranging from 20 - 80 pcf and are useful for well-behaved, free-flowing materials only. Fox maintains a comprehensive database of hundreds of other materials, including a list of 'difficult-to-convey' materials for which we have excellent solutions but for which the above curves are not reliable. Required air flow rates, in SCFM, are shown at the far right. Please note that these curves do not represent the performance of a single eductor as inlet pressure is changed, but rather each point represents an eductor with a nozzle designed specifically to operate at the design inlet pressure.

Dimensional Information — Solids Conveying Eductors



Eductor Discharge/ Line Size	Motive	Suction	A	B	C
1"	1/4"	1"	6.4"	2.5"	5.5"
1-1/2"	1/2"	1-1/2"	7.8"	2.9"	6.0"
2"	1"	2"	12.8"	4.4"	9.6"
2-1/2"	1-1/4"	2-1/2"	15.5"	5.4"	11.9"
3"	1-1/2"	3"	18.8"	5.6"	14.3"
4"	2-1/2"	4"	23.9"	6.8"	18.4"
5"	3"	5"	29.0"	8.6"	22.5"
6"	3"	6"	33.3"	9.8"	26.1"
8"	4"	8"	45.3"	9.5"	42.8"

Standard connections are NPT, plain pipe ends, flanges, or, on the discharge only, standard tube OD. Any other connection can be provided, including Victaulic, sanitary, BSP, quick-couplings, DIN flanges or special adaptors. Just ask. Standard materials are carbon steel and 304 stainless, but any commercially available material may be specified. Special options include a huge variety of surface coatings, hi-temp versions, and customized configurations.

Fox requires completion of our Application Data Sheet so that we can provide performance-guaranteed eductors.

Additional Technical Product Information

The following materials are available upon request:

Bulletins:

- *Fox Blower/Eductor Subsystems for Pneumatic Conveying using **Rotron or PD Blowers** - Bulletin 302*
- ***Flue Gas** Conditioning with Fox Systems - Bul. 305*
- ***Pre-Coat** of Filter Media with Fox Systems - Bul. 306*
- ***Cement** Plant Applications of Fox Eductors - Bul. 307*
- ***Reclaiming** from Screeners, Dust Collectors, and Packaging with Fox Eductors - Bulletin 315*
- *Retrofitting **Foundry** Dust Collection - Bul. 318*
- *Eductors for **Plastic** Compounders - Bulletin 336*
- *Rotary Valve Venting Eductors - Bulletin 360*
- ***Food** Processing and Fox Eductors - Bul. 350*

Published Case Histories/Color Reprints

- *Ten Years of maintenance-free conveying with Fox eductor at metal processor*
- *Dried sludge at cogen power plant*
- *Pigment powders at dye mfr.*
- *Spent sand and grit at ductile iron foundry*
- *Limestone dust at Mexican mine*
- *Metal powders at magnet producer*

***Fox Case Studies** describe specific installations in a range of industries, showing mating process equipment.*

Food:

63	Corn snacks from extruder
59	Frozen cranberries
55	Puffed rice from reel
50	Oat bran from dust coll.
49	Ground coffee; screener
42	Cereal; package reclaim
39	Sugar; bulk bags
34	Whey; spray dryers
24	Salt flakes; screw feeder
17	Minors; spices - screw fdr.

Power/FGD:

52	Hydrated lime, FGD
27	Limestone, screw feeder
23	Pulv. coal, fluid bed
10	Fluid coke
6	Flyash at 700° F

Plastics:

45	Cryogenic grinding; mill
44	Screener - overs/unders
47	Acrawax feed to line
4	Reduce streamers and angelhair

Metals/Foundry:

61	Foundry dust from six-module baghouse
43	Foundry sand, bagh'se
33	Alumina, cyclone
20	Copper pellets, 400 pcf

All case studies can be downloaded from our website

F O X

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