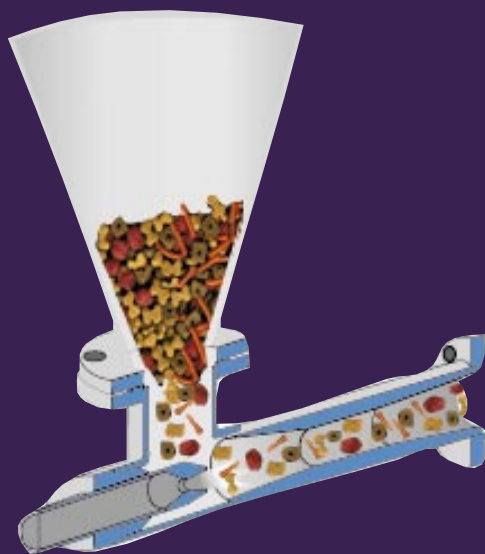
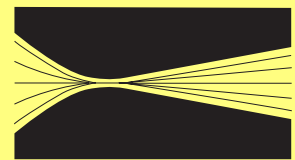


*Fox*  
*Venturi Eductors*  
*in the*  
*Food Industry*



*Bulletin 350*

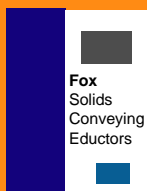


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# Fox Venturi Eductors: Conveying Food Ingredients and Products *with No Moving Parts*

Since 1963, Fox Venturi Eductors have been installed to pneumatically convey bulk solids with no moving parts. Approval by the USDA in 1987 enabled Fox sanitary eductors to become extensively used throughout the food and dairy industries.

Detailed technical information about the operation and performance of Fox eductors, including data concerning throughput (transfer rate), estimating line size and air consumption, and blower power requirements, are contained in other Fox product bulletins summarized below. These brochures are available upon request. This brochure focusses specifically on the use of Fox venturi eductors in food manufacturing and processing facilities.



**General Technical Data:  
Fox Venturi Eductors**  
Bulletin 301  
(Also available: 301-Metric)



**Performance of Eductor-  
Blower Combinations:  
Rotron & PD Blowers**  
Bulletin 302



**Reclaim & Disposal of  
Food Products**  
from Screeners, Dust Collectors,  
and Packaging  
Bulletin 316

## Fox Eductors... Conveying with No Moving Parts.

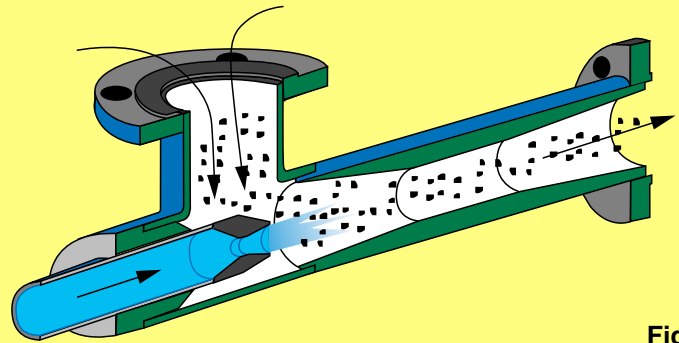


Fig. 1

Fox eductors use low pressure air, at 2-14 psig, to convey powders, granules, flakes, and extruded food products with no moving parts, no maintenance, no blowback, no safety hazard and – quite possibly – no degradation.

## Fox Sanitary Eductor Systems



Fig. 2  
Spray  
Dryer  
Fox Sanitary  
Eductor  
Cooler  
Rotron  
Blower

Fox eductors are used to entrain powders, flakes, and granules and transport them in positive, dilute-phase pneumatic conveying lines. Fox can integrate standard or USDA-approved eductors with appropriately selected blowers, coolers, feeders, hoppers, diverter valves, controls, and other equipment to produce conveying systems with a minimum of moving parts.

Fig 2 shows a small Fox sub-system, including a blower, cooler, and eductor, that has been in service conveying non-dairy creamer for ten years with almost no maintenance.

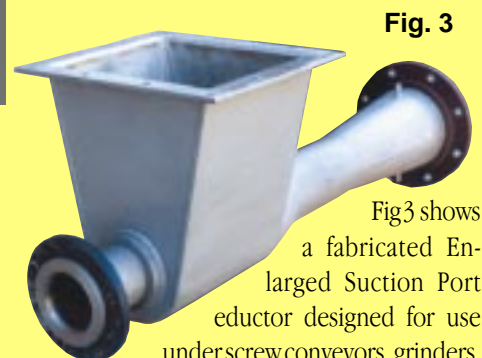


Fig. 3

Fig3 shows a fabricated Enlarged Suction Port eductor designed for use under screw conveyors, grinders, or other equipment with large product outlets. Dimensions are customized to mate to existing equipment and flanges.

# Fox Sanitary (USDA-Approved) Eductors: Conveying *Without* Airlocks, *Without* Blowback, *Without* Maintenance, *Without* Shearing

## Fox Sanitary Eductors

Fig. 4



Fox Sanitary Eductors perform identically to standard (industrial) Fox eductors but are designed specifically for use in CIP (Clean-In-Place) systems in the food industry. To facilitate easy cleaning and inspection of internals, for avoiding both bacterial contamination and product cross-contamination, Fox food-grade, USDA-approved eductors include these key features:

- **Highly polished internals, with polished and ground welds.**
- **No cracks, threads, corners, or 'dead spaces.'**
- **Tri-Clamp ( or other sanitary) end connections. .**
- **No tools required for disassembly.**

## An Alternative to Sanitary Airlocks:

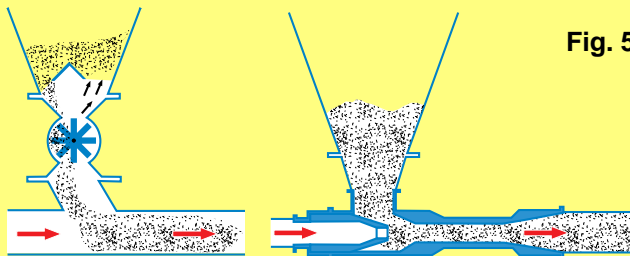


Fig. 5

Airlocks are frequently selected for use in food processing systems even though they may not be the most appropriate choice.\* Consider these advantages of eductors:

- **Cost** – Food-grade airlocks typically cost 3-5 times the price of sanitary eductors.
- **Housekeeping** – Airlocks feeding positive systems inevitably produce blowback which creates dust, pest, and housekeeping problems. Blowback doesn't exist with eductors.
- **Maintenance** – Fox eductors require no maintenance. There are no seals to replace, no bearings to fail, no spares to stock.
- **Metal Contamination/Safety** – This is not a concern with eductors. There is no scraping or metal-to-metal contact. There is no safety hazard.

\* Fox sanitary eductors cannot eliminate airlocks in all food applications. Eductors are rarely used to handle rates over 16,000 #/hr, nor to convey over distances farther than about 300 ft.

What food products have been conveyed with Fox Eductors?

**Apple Bits**  
**Beans**  
**Bread Crumbs**  
**Cake Mix**  
**Cinnamon**  
**Cocoa Powder**  
**Corn Snacks**  
**Dextrose**  
**Flour**  
**Gelatine**  
**Lactose**  
**Maltrin**  
**Milk Powders**  
**Oat Fibers**  
**Peanuts**  
**Raisins**  
**Starch**  
**Sugar, Salt,  
& Spices**  
**Tea Powder**  
**Vitamins**  
**Walnut Shells**  
**Wheat Germ**  
**Whey**

# Conveying Fragile Products with Fox Venturi Conveying Without Breakage, Damage, and

Fox eductor systems have been used for over twenty years to replace belts, bucket elevators, and fork lift traffic, automating the handling of fragile food products that many once thought were not capable of being conveyed pneumatically:

Snack Foods  
Breakfast Cereals  
Bread Crumbs  
Shelled Peanuts  
Potato Flakes  
Cheese Balls  
Puffed Rice  
Wheat Strands  
Frozen Cranberries  
Raisins  
Granular Gelatine  
Marshmallow Pieces  
Mustard Seeds  
Apple Bits  
Cacao Bean Shells  
Green Coffee Beans  
Potato Chip Waste

## The Five Steps to Conveying Fragile Products at Your Plant:

### Step 1: Eliminate Airlocks

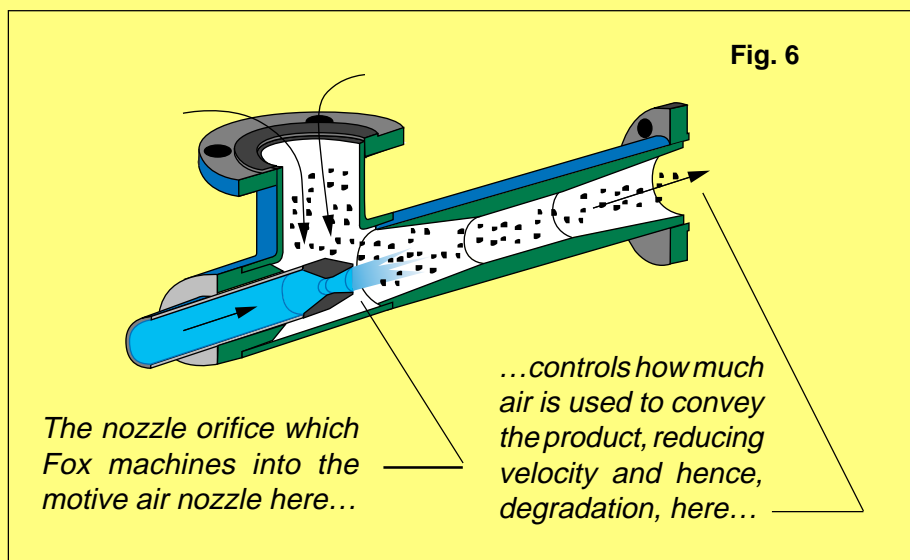
Rotary valves (airlocks) are simply not suitable for conveying fragile materials. As the rotor sweeps across the product inlet, the inevitable shearing of particulates creates broken pieces and fines. Pneumatic conveying of fragile particulates can rarely be accomplished without the elimination of moving parts.

### Step 2: Testing at Fox Valve's Test Facility

There are no theoretical models to predict whether a cereal, coffee bean, or raisin can be conveyed without damage. Fox has run hundreds of conveying trials at our test lab, which has proven extremely reliable at predicting whether your product can or cannot be conveyed without damage. If the tests are successful, Fox can ascertain what minimum transport velocity is suitable for your product. Customers are always welcome to witness these trials. Our facility is 45 minutes from Newark Airport (EWR.)

### Step 3: Limit Conveying Velocity

Minimizing transport velocity is the single most important factor in successfully transporting friable materials. Unlike airlocks, an eductor always rigidly controls how much air enters the transport system from the blower via the motive nozzle orifice. By carefully sizing this orifice, Fox can engineer into our equipment an upper limit on how much air enters the system — therefore limiting downstream conveying velocity.



# Fox Eductors: Twenty Years of a Fines Generation.

## Step 4: Proper Blower Selection

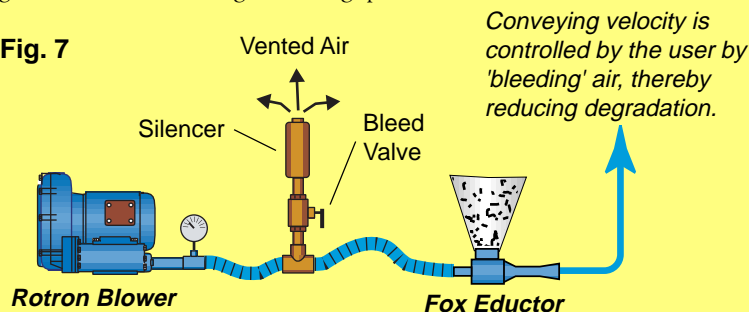
Quiet, maintenance-free Rotron blowers are usually supplied, facilitating a compact installation with a very small footprint. Rotron blowers can be used to drive systems with 1" to 6" convey lines. Fox will, of course, integrate positive displacement blowers into our solution if dictated by throughput or conveying distance.

## Step 5: Field Adjustable Equipment: Letting the User Assert Control over Transport Velocity:

### Inclusion of the Fox Bleed Valve Assembly

Lab testing is one thing; actual production is something else. And will the product Fox tested last year be the same product you're making next year? Fox conveying systems for fragile products usually include an elegantly simple means for you or your operators to adjust, reduce, or control product transport velocity. The bleed valve assembly permits you to vent off, through a silencer, a portion of the blower output. This enables you to respond to changing conditions in your process and use the highly flexible Fox system to deliver a transport velocity that you can control. If a different product requires lower velocities, you can bleed off more air to convey more slowly. If another product is denser and less prone to damage, you can reduce the bleed and convey at higher velocities with a higher throughput.

Fig. 7



## Addendum: Good engineering practice

Performance of any well-designed system can be enhanced by good engineering practice – and this is particularly true for minimizing degradation. Many elements in a transport system can contribute to minimizing product degradation: well-aligned pipe joints, properly sized bends, carefully selected diverter valves, an appropriate receiver, etc.

### What Velocity Do We Need?

### What Velocity Should We Use?

Typical convey velocity in a typical conveying system with a typical product (bulk density between 20 - 100 #/ft<sup>3</sup>) is about 3500 - 5000 ft/min. The common impulse to add excess capacity to a system's blower "just to feel safe" has the unfortunate result of increasing transport velocities which can result in an unnecessarily degraded product.

After Fox's test lab determines what velocity is best for your product, we'll select a blower to deliver air flows consistent with a prudent margin above that minimum convey velocity. Operators can then use the Fox Bleed Valve Assembly to fine-tune or reduce product speed as low as your comfort level will allow. We have engineered systems to convey certain products at velocities as low as 1100 - 1500 ft/min. However, only testing can determine what is the minimum for your material.

## Fox Eductors for Easier, Faster Clean-Outs to Eliminate Cross-Contamination with Smaller Batches

Perhaps there was a time when it made sense for maintenance workers to wash out 150 buckets on a bucket elevator when production switched to another product. If you only ran 30 different products a year, perhaps that could work. Not any more.

These days, you can be packaging poppy seeds in the morning and sesame seeds in the afternoon, or garlic flakes on Friday and onion flakes on Saturday morning. The market's tolerance for cross-contamination is zero. How do you ensure product quality? Switching to pneumatic conveying with Fox eductors offers quick, easy, clean-outs.

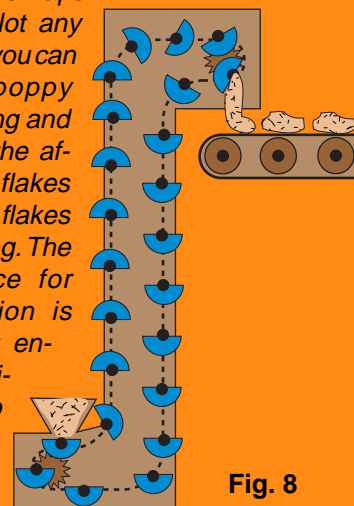


Fig. 8

Are you sure a bucket elevator is really necessary? Is your product really too fragile to be conveyed pneumatically - or just too prone to shearing to be conveyed with airlocks? Perhaps it is no more fragile than the breakfast cereals, snack foods, coffee beans, trail mix, or a hundred other food products already being conveyed with eductors. Contact Fox to arrange a free degradation trial in our test lab.

# Where to use Venturi Eductors ...

Wherever bulk solids are discharged in your manufacturing process, whether from a mixer, screener, bag dump, feeder, or extruder, it is almost certain that Fox has made this identical installation before. Here is a quick overview of common applications in the food industry where Fox eductors are used in combination with other solids-processing equipment.

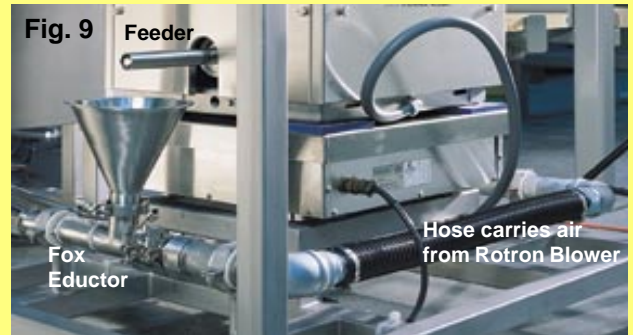


**Enlarged Suction Port (ESP) eductors** are often used when handling chunks, flakes, or unusually shaped products. They also permit easy installation beneath existing equipment, such as screw conveyors, dust collectors, etc. Building the inlet transition as an integral element of the eductor avoids bridging problems caused by poorly designed or inadequately polished components provided by others. Mating flange is made to your specifications. ESP Eductors can be built in fully sanitary, or non-sanitary versions, but all are easy to disassemble and clean.

6

## Conveying from **Screw Feeders**

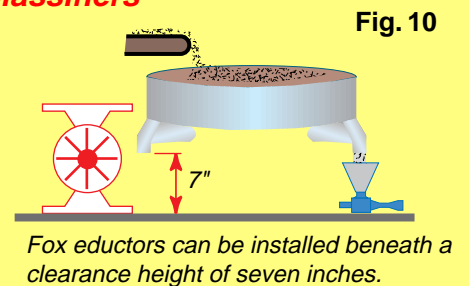
Fox eductors have been used beneath loss-in-weight and volumetric screw feeders for over thirty years. Some installations have more than one screw feeder feeding many minor ingredients. Eductors convey minors to mixers, bins, and frequently into larger convey lines.



## Conveying from **Screeners or Classifiers**

The low clearance height of Fox eductors (Fig. 10) makes them ideal for placing beneath the outlets of screeners and sifters. Sanitary airlocks, because of their cost and size are often not suitable for reclaiming 'overs' and 'unders', yet reclaiming these waste streams can be very important to plant profitability.

Fox has retrofit many systems where airlocks were installed beneath classifier outlets and where blowback severely degraded screener performance. Eliminating the blowback, by replacing the airlock with a Fox eductor, (Fig. 11) solves this problem.



Fox eductors can be installed beneath a clearance height of seven inches.

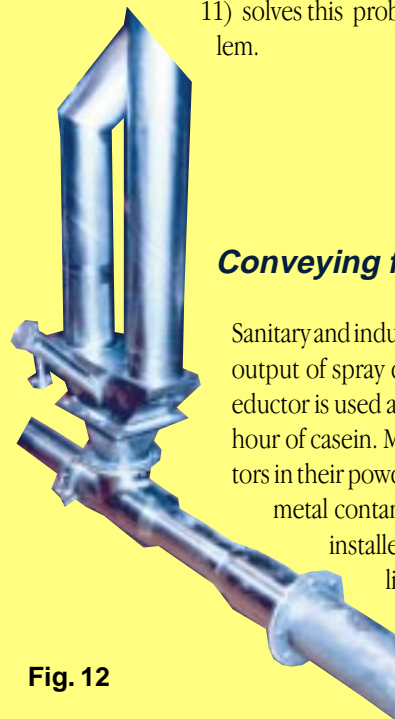
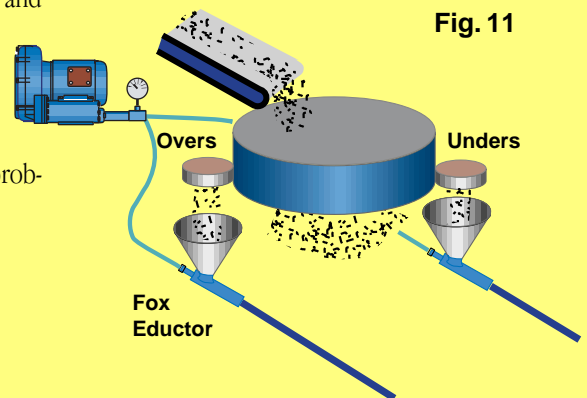


Fig. 12



## Conveying from **Spray Dryers**

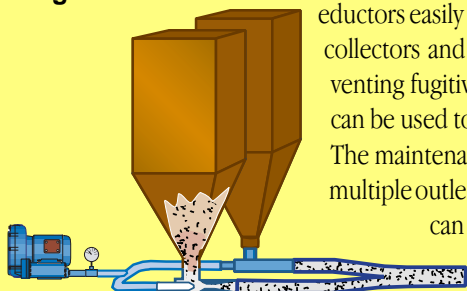
Sanitary and industrial-grade Fox eductors have been used to handle the output of spray dryers since 1981. In the photograph at left, a 6" Fox eductor is used at a dairy in New Zealand to transfer 19,000 pounds per hour of casein. Many New Zealand dairies replaced airlocks with eductors in their powdered milk handling systems to minimize the chance of metal contamination in their product. Fox eductors are currently installed beneath hundreds of spray dryers handling products like whey, artificial sweeteners, creamers, carrageenan, skim milk powders, and powdered tea and coffee.

# ... in YOUR Plant?

## Conveying from **Dust Collectors**

Hundreds of Fox eductors are installed under dust collectors, either for removal of waste or to reclaim valuable product. Unlike airlocks, which can puff and leak, eductors easily overcome the slight negative pressure of most dust collectors and provide clean, leak-tight conveying of dust, preventing fugitive dust emissions. As shown in Fig. 13, one blower can be used to drive many eductors located under many outlets. The maintenance advantage over using a screw conveyor to link multiple outlets is significant: with eductors, all the other modules can remain operational while one is being cleaned. Optional dump ports make access to internals and removal of foreign objects easy.

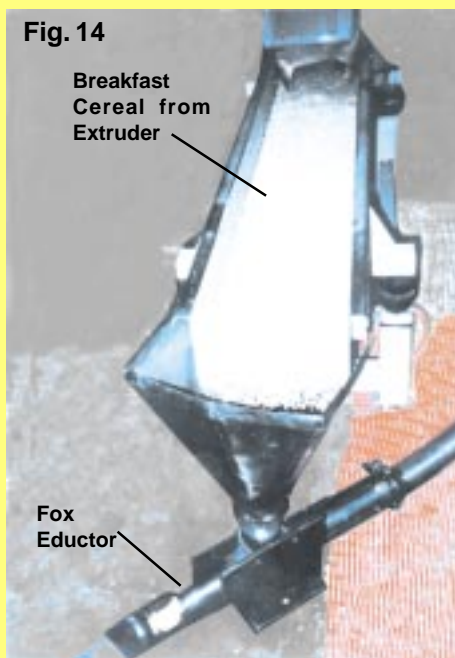
Fig. 13



## Conveying from **Belt Conveyors**

Fox eductors are often installed at the end of belts or vibratory feeders. At right is a photo from a cereal plant where a variety of different breakfast cereal products were conveyed directly to final packaging through a 4" Fox eductor. Rather than use a homemade hopper (as shown) Fox can provide whatever inlet transition or hopper is appropriate, built to whatever quality/finish you require.

Fig. 14



## Conveying from **Bag Dump and Bulk Bags**



Fig. 16

Fox venturi eductors are perfectly appropriate for use in bag dump stations when handling a free-flowing, granular material. A common application is in packaging areas, where reject bags can be emptied into a small hopper and transported, without product degradation, back into the packing bins for re-packaging as final product.

## Conveying from **Extruders**

A large variety of products have been conveyed directly from extruders using Fox eductors, particularly snack foods. These are typically conveyed to a dryer, where they then become the crispy, fragile products familiar to us all. However, while still retaining some moisture, they can be very effectively conveyed using Fox eductor systems with a bleed valve. In Fig. 17, an 8" eductor and 8" lines are used to convey a snack product shaped like an onion ring about 2" in diameter. Fox eductors are used extensively at pet food plants conveying extruded dog and cat foods.

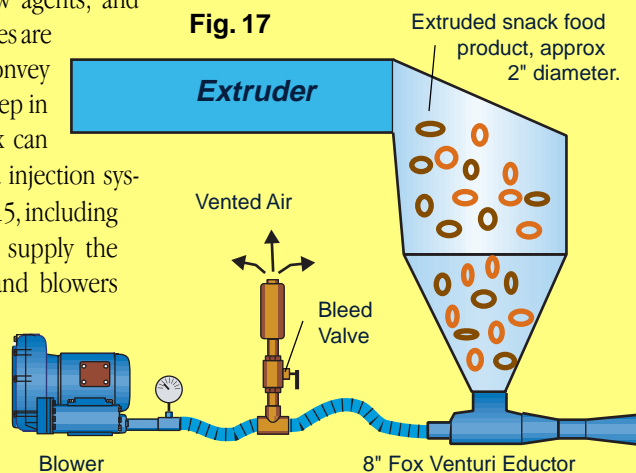
Fig. 15



## Complete Additive Systems

Hundreds of Fox systems are in use adding spices, flavorings, vitamins, flow agents, and minor ingredients. These additives are injected into mixers, blenders, convey lines, or any other convenient step in the manufacturing process. Fox can supply complete skid-mounted injection systems, as shown in Fig. 15, including a vacuum loader to supply the screw feeder. Skids and blowers suitable for wash-down, as shown in Fig. 9, are also available.

Fig. 17



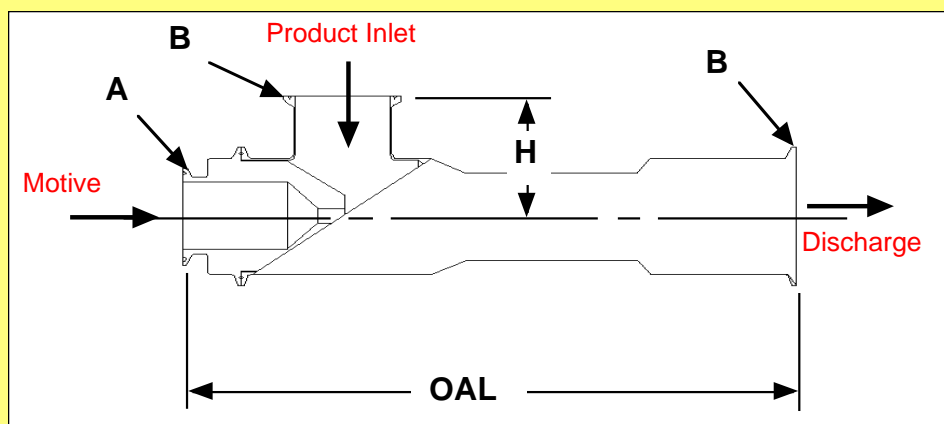
## Case Studies

The following compact, one page case studies include an operational schematic of the installed system, along with performance details, and are available upon request and on our web site.

### CS # Material...Conveyed From:

17	Minor Ingrid.	Screw Feeder
19	Artif. Sweetener	Spray Dryer
21	Skim Milk Powder	Spray dryer
22	Casein	Spray Dryer
24	Salt flakes	Screw feeder
26	Chewing Gum	Cutter
32	Flour	Silo
37	Peanuts	Classifier
42	Extruded dog food	Bag dump
49	Coffee beans	Screener
50	Oat, bran dust	Dust Collector
55	Puffed Rice	Coating Reel
56	Coffee Beans	Bulk Bags
57	Cacao Bean Shells	Screener
59	Frozen Cranberries	Freezer
63	Corn snacks	Extruder

## Dimensional Data - Fox Sanitary Eductors



B	A	OAL	H
1-1/2"	1"	12"	2-1/8"
2"	1-1/2"	14-1/4"	2-1/4"
3"	2"	18-1/2"	3-1/8"
4"	3"	24-1/4"	4-1/8"
6"	4"	28-1/2"	6"

Fox Sanitary Eductors are stocked in 304 stainless. 316 units are typically available in 4 - 6 weeks. Standard end connections are Tri-Clamps, but plain ends, for use with compression clamps, or any commercially available sanitary fitting can be specified. A wide variety of special internal coatings are available for use with cohesive powders.

## About Fox Valve...

Fox Valve was founded in 1961, specializing in high performance venturi products. Fox first provided venturi eductors for transporting bulk solids in 1963, conveying plastic pellets with air at 4 psig. We've been providing the food, plastics, chemical, cement, and other industries with eductor transport systems ever since.

Fox has been supplying food companies with venturi eductors since the early 1980's. Moreover, hundreds of Fox eductors have been included with OEM equipment, such as extruders, spray dryers, and dust collectors. Fox eductors have been installed in a wide range of food applications in Europe, Asia, and Latin America. Our confidentiality agreements with many food manufacturers prevents our describing many of these installations.

## To Receive a Quotation:

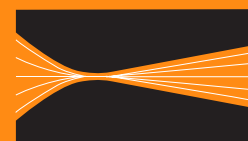
Request and complete our Application Data Sheet.

### Additional Technical Literature

The following materials are available upon request:

#### Bulletins:

- 302 — Pneumatic Conveying with Fox Eductor/Blower Systems
- 306 — Enhancing Dust Collector Perf. w/Fox Pre-Coat Systems
- 316 — Reclaiming Food Product from Screeners, Packing, Dust Coll.
- 336 — Applications in Plastic Compounding with Fox Eductors
- 203 — Steam Jet Ejectors and Vacuum Systems; including Evaporative Cooling of Kettles and Retorts
- 205 — Thermocompressors, used in Evaporator Systems
- 261 — Steam Spargers and Tank Heaters
- 280 — Air Jet Ejectors
- 101 — Liquid Eductors
- 106 — Slurry Eductors



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