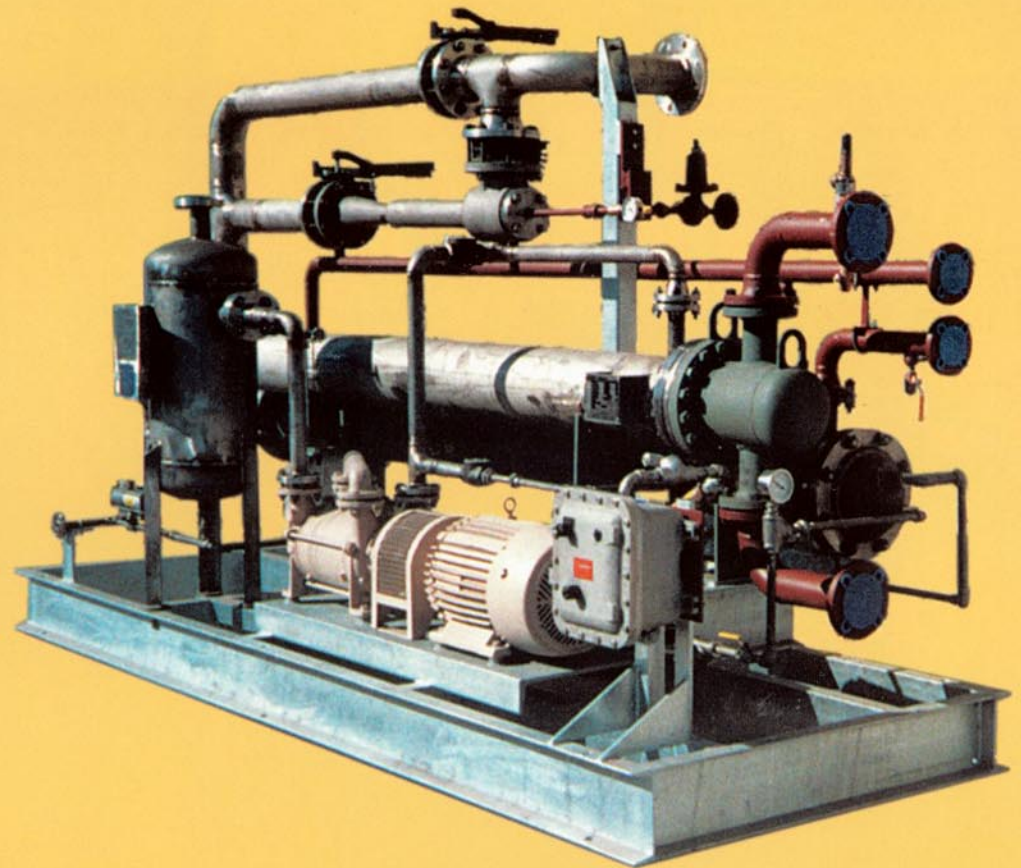


from Fox Valve...

# FOX STEAM JET EJECTORS AND VACUUM SYSTEMS



Bulletin 203



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# Why Fox Ejectors?

Fox Valve is an engineering company providing quality engineered products with a problem-solving approach. We have forty years of experience designing and building venturi products for demanding applications. Processes requiring ejectors to be manufactured of stainless, PVDF, TFE, titanium, and other exotic materials are standard for Fox Valve. Visual inspection, dye penetrant testing, or radiographic inspection are part of our normal nondestructive testing procedure.

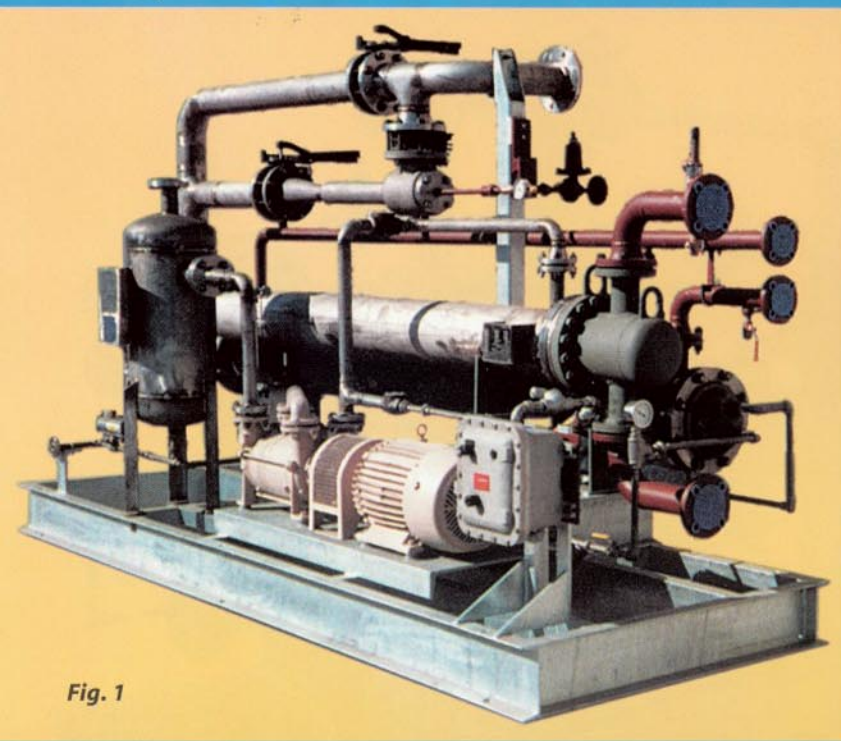


Fig. 1

*A skid-mounted, three stage combination (hybrid) system includes a liquid-ring vacuum pump (LRVP) intended for use in the chemical industry. The turnkey package includes controls and valves.*

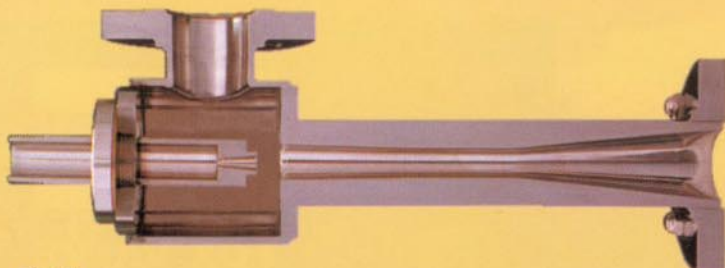


Fig. 2

*A cross section of a steam ejector built in Fox Valve's in-house manufacturing facility. Outstanding workmanship is a legacy of Fox Valve's origins as a supplier of highly engineered aerospace products.*

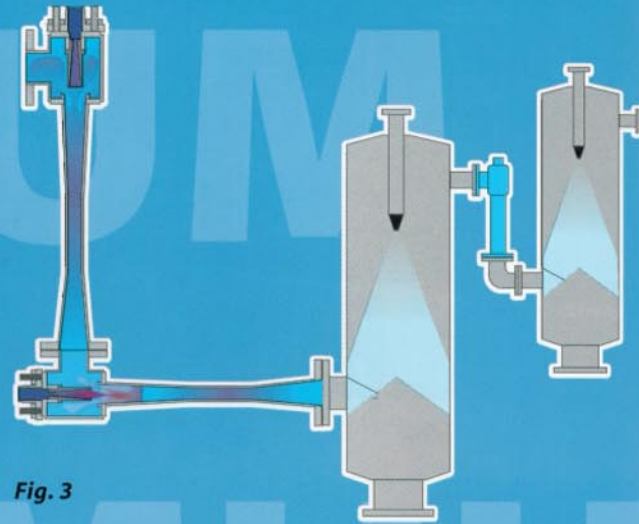


Fig. 3

*Schematic of a three stage system incorporating direct contact (barometric) condensers, as might typically be used in a vegetable oil deodorizer application.*

Fox ejectors are applied in food process, pharmaceutical, chemical, petrochemical, and pulp & paper installations. Complete skid-mounted, turnkey packages (See Fig. 1) including instrumentation, can be supplied to suit your requirements. Systems are engineered to interface with our customer's design scheme.

## Why use Fox?

**FAST RESPONSE**

**QUICK SUBMITTAL OF APPROVAL DRAWINGS AND OTHER PROJECT DOCUMENTATION.**

**FAST, RELIABLE DELIVERIES**

**IN-HOUSE MANUFACTURING**

# Chemical Process Industry...

## Single and Multi-Stage Steam Jet Ejector Vacuum Systems

Fox steam jet vacuum systems are available from single stage stock units operating at low vacuums to custom-designed five stage systems capable of high vacuum levels to 0.1 Torr. Suction sizes ranging from 1" to 72" diameter are our specialty. Units machined from bar stock to fabricated ejectors, shell-and-tube surface and direct-contact condensers are part of our engineering expertise. Fox multistage vacuum systems are in service maintaining vacuum on towers and reactors in the process industries. Installations include vegetable oil deodorizers, distillation processes, evaporators, and crystallizers, to name a few.

### VACUUM LEVEL

Vacuum levels down to 0.1 Torr can be obtained with multi-stage systems. How many stages do you need? See Fig. 5 for an approximation.

### CONDENSERS

Indirect Contact—Shell and Tube

Direct Contact—Barometric

### SKID-MOUNTED SYSTEMS/ TURNKEY PACKAGES

Complete with instrumentation, interconnecting piping and valves (See Fig. 1.)

### HYBRID SYSTEMS

Combination steam jet/liquid ring pump.

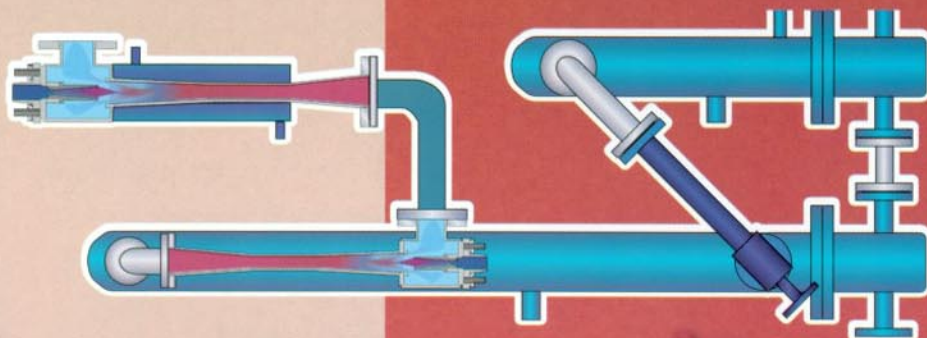


Fig. 4

A schematic of a three-stage ejector system using shell and tube condensers. The first stage is jacketed to prevent freeze-up.

### How Many Stages Do I Need?

#### Atmospheric Pressure

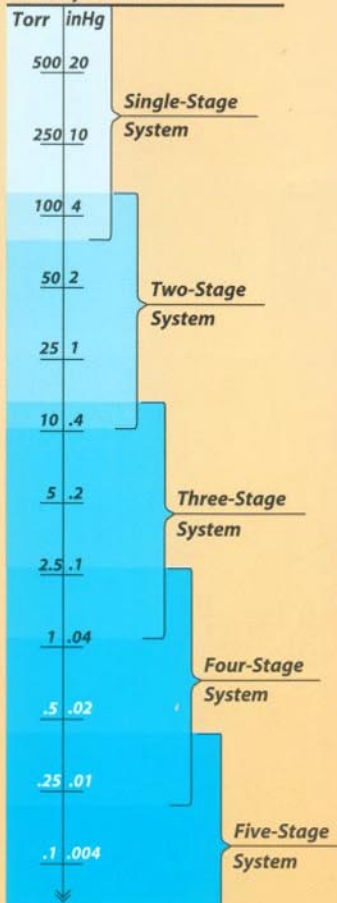


Fig. 5



Fig. 6

A single stage ejector with heat tracing and an insulation blanket on the diffuser to avoid ice buildup.

# for Evaporator Applications...

## Thermocompressors

Fox thermocompressors are steam jet ejectors used to boost low pressure steam up to a higher usable pressure. Thermocompressors are ideal for reclamation of low pressure waste steam and condensate. Fox has supplied hundreds for inclusion on food and chemical evaporators, desalinization systems, and vapor recompression applications. Although most operate within a vacuum, many are designed to cover a range from vacuum to a positive discharge pressure.

## Evaporators, Concentrators, Crystallizers, Desalinization

Waste condensate can be collected and flashed to a usable steam pressure using Fox thermocompressors, which are currently operating in hundreds of the above applications. The addition of a thermocompressor in an evaporation system reduces live steam consumption and can reduce the number of evaporation stages.

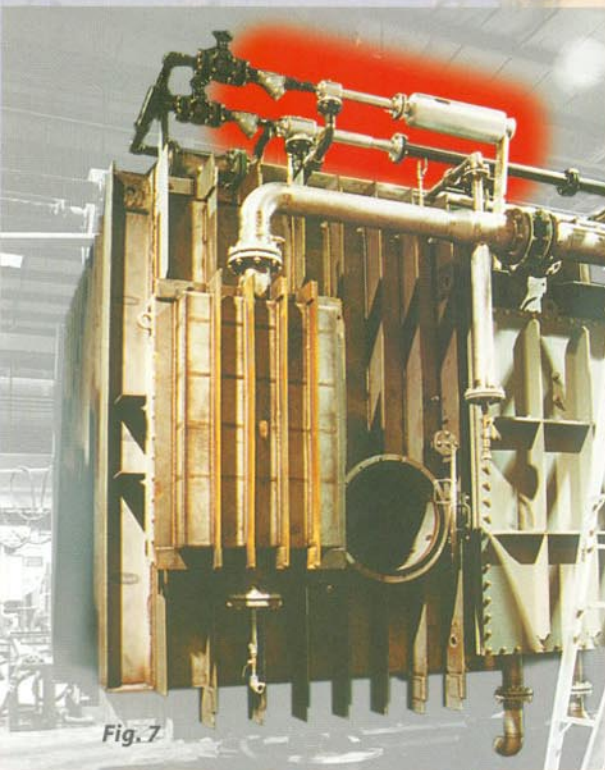


Fig. 7

*A Fox thermocompressor and vacuum stages installed on a large, multi-effect desalinization evaporator. The thermocompressor recycles waste steam, increasing the efficiency of the evaporator.*



Fig. 8

## Typical Application of Fox Thermocompressors: Concentrating Freshly Squeezed Tomatoes

**DURING THE EVAPORATION OF SQUEEZED TOMATOES TO A DENSER SLURRY, LARGE AMOUNTS OF VAPOR ARE GENERATED WHICH CAN BE RECYCLED BACK INTO THE SYSTEM WITH A THERMOCOMPRESSOR, REDUCING THE QUANTITY OF LIVE STEAM REQUIRED.**

*Three 20" Fox thermocompressors installed at a large tomato processing plant in Canada.*

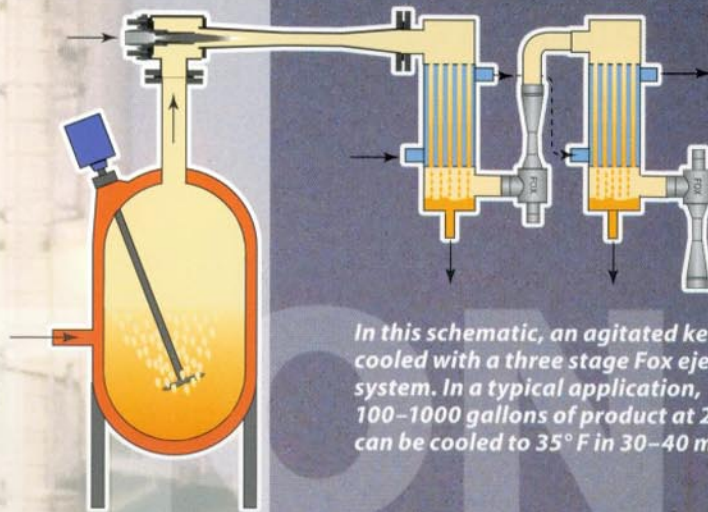


Fig. 9

# for the Food Industry...

## Evaporative Cooling with Fox Ejector Systems

Fox engineers are some of the most knowledgeable in industry today concerning the evaporative cooling of kettles and retorts using steam jet ejector systems. Evaporative cooling has significant process and product advantages: faster manufacturing cycles; longer product shelf life, and reduced product handling.



*In this schematic, an agitated kettle is cooled with a three stage Fox ejector system. In a typical application, 100-1000 gallons of product at 200° F can be cooled to 35° F in 30-40 minutes.*

Fig. 11

## Deodorizers Ejector Systems for Vegetable Oil

Multistage Fox ejector systems have been used for years to deodorize vegetable oils, often comprised of four or five stages.

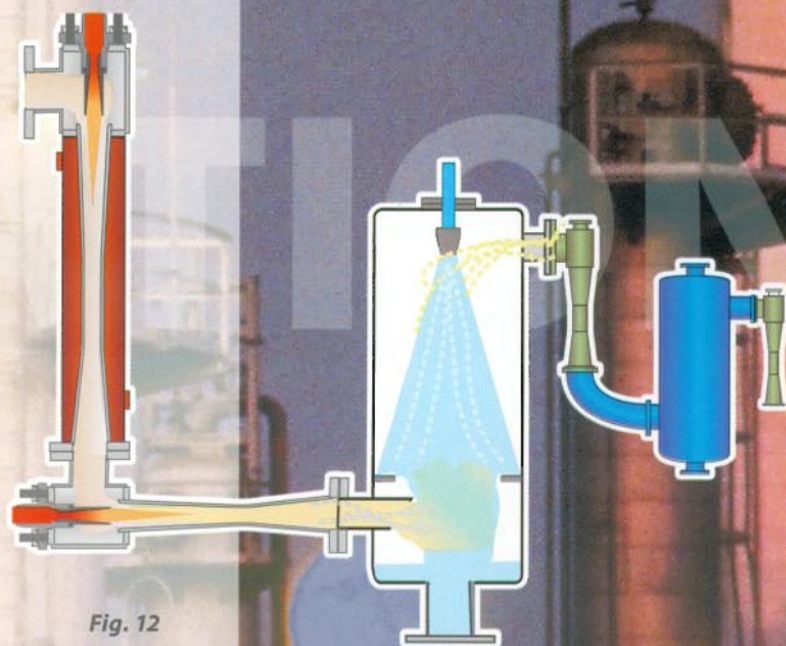


Fig. 12

*This schematic illustrates a four stage ejector system typical of that used for vegetable oil deodorizing.*

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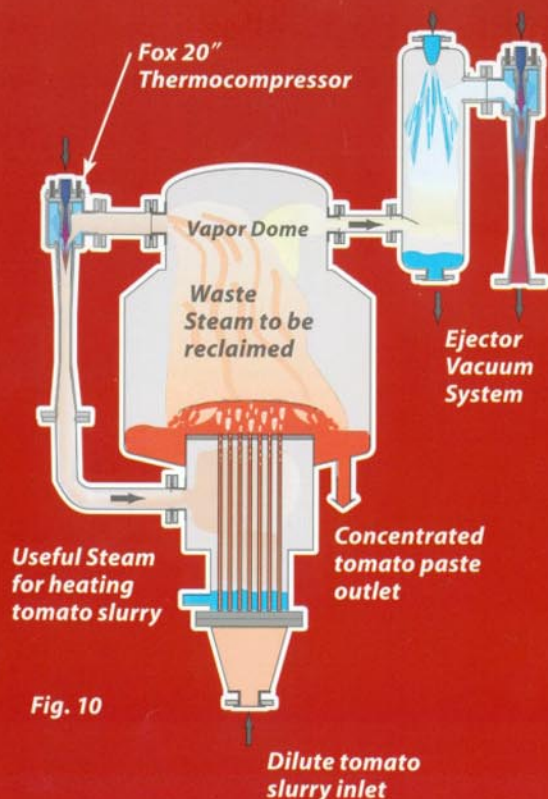


Fig. 10

Dilute tomato  
slurry inlet

# for Aerospace Technology...

## Ejectors for Wind Tunnels, High Altitude Simulation and Research

Fox ejectors have been used extensively in aerospace applications. Wind tunnels, high altitude simulation chambers and test facilities use Fox air and steam ejectors, such as the large two-stage air ejector system shown in Fig 13. Ground test equipment often requires custom-built ejectors to meet severe operating conditions, including high temperatures and pressures. Fox has supplied ejectors for use in high-energy laser research projects rated to 4500 psig. Our legacy as a supplier of flight-qualified hardware makes us ideally suited to supply ejectors for aerospace applications.

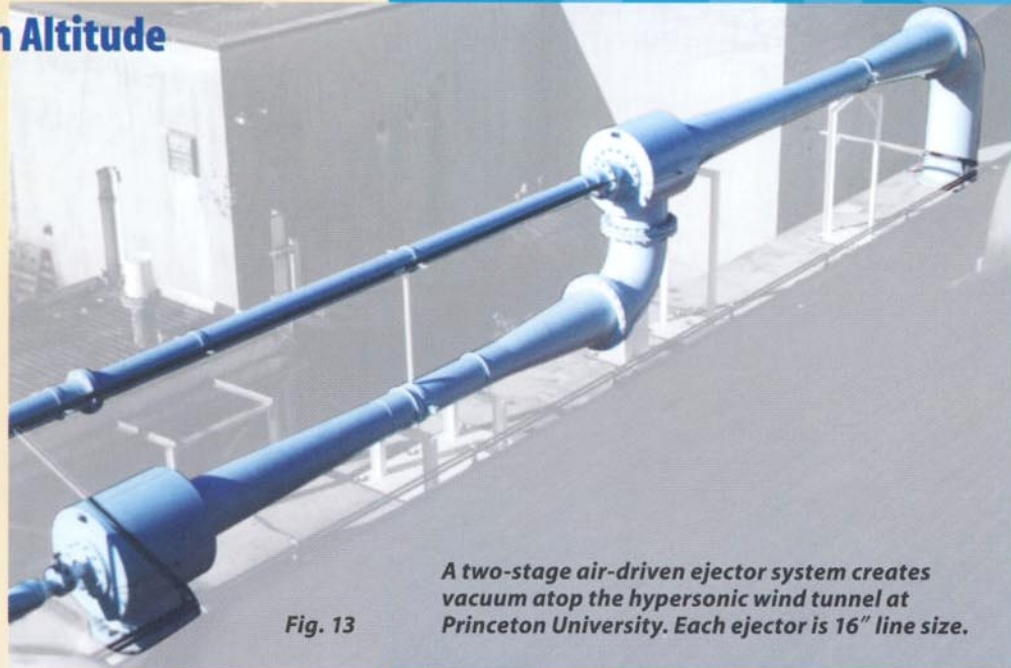


Fig. 13

*A two-stage air-driven ejector system creates vacuum atop the hypersonic wind tunnel at Princeton University. Each ejector is 16" line size.*

# for Paper & Pulp...

## Titanium Ejectors for Use in Chlorine Systems

Fox is the leading global supplier of titanium ejectors with literally hundreds installed in paper mills throughout the world. Typical installations include chlorine bleach plants handling chlorine and chlorine dioxide gasses.

Fox emerged as the leading supplier of titanium ejectors for handling highly corrosive fluids because of our 35 years of experience building venturies for spacecraft. This expertise is available to the paper and chemical process industries and enables Fox to offer extremely corrosion resistant titanium ejectors with competitive prices and deliveries. They may be specials to others, but not to us. Typical delivery for a titanium ejector is six weeks.



Fig. 14

*A Fox titanium ejector. Fox uses a unique, proprietary fabrication process which delivers unsurpassed manufacturing quality and results in exceptional performance.*

# for Pharmaceutical...

## Plastic-lined Pipe Ejectors for Highly Corrosive Applications

Many pharmaceutical and chemical applications require single and multi-stage ejector systems handling extremely corrosive fluids. Rather than supply fragile graphite or glass ejectors, Fox supplies our standard 'PLP' ejectors, for use in glass or Plastic Lined Pipe (PLP.) Available with all Teflon, Kynar, or Polypropylene wetted parts, these rugged ejector assemblies are fully armored for durability and are available with much shorter deliveries and at lower cost than graphite ejectors.

## Solvent Recovery

A common application in pharmaceutical production is the recovery of solvents such as toluene, acetone, or ethylene glycol (EG.) Fig. 17 shows a schematic of a typical process using steam to drive a two stage, ejector vacuum system comprised of PLP ejectors and a condenser with all Teflon wetted parts.

Certain solvents and chemicals such as tetrahydrofuran, EG, and xylene may not be suitable for use with graphite or other proprietary corrosion resistant materials, but are easily handled by Fox all TFE wetted part ejectors.

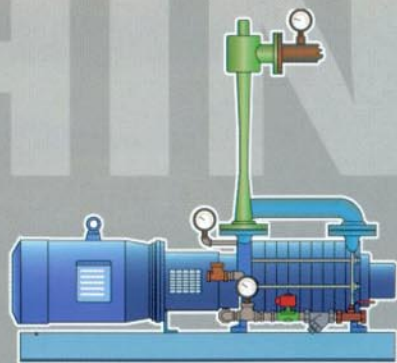


Fig. 18

Fox air ejector boosters upstream of a LRVP increase vacuum capability from typically 50 Torr to 10 Torr.



Fig. 15

A PLP eductor is assembled with both the motive nozzle (above left) and venturi diffuser (above right) machined from solid plastic rod—either TFE, PDVF, or Polypropylene. These are then assembled into a standard lined pipe tee. A fully assembled unit is shown below.



Fig. 16

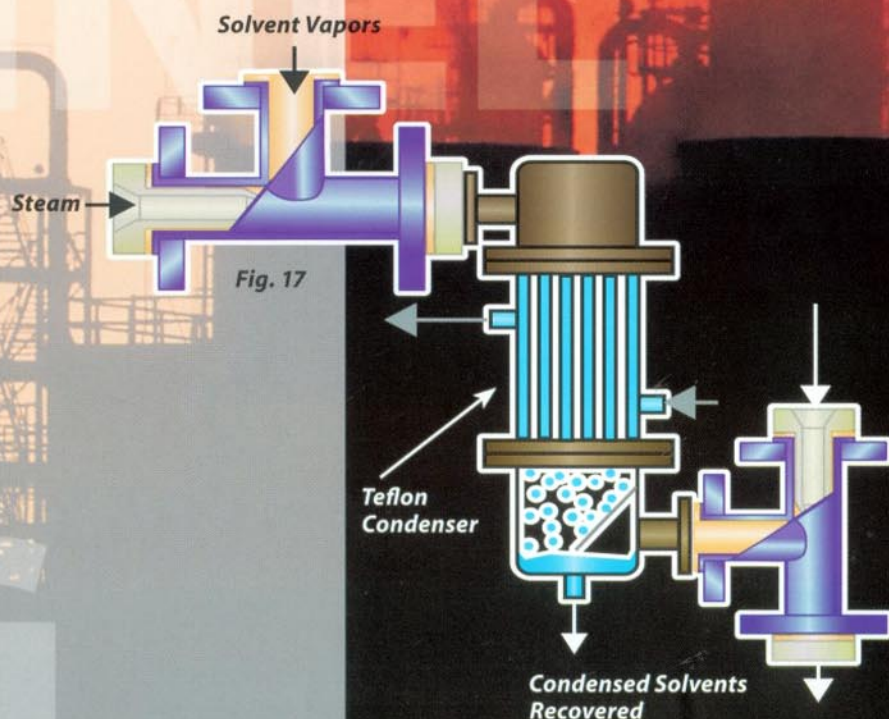


Fig. 17

# Participating in Your Project...

It takes more than just building quality hardware to be successful in today's engineering environment. Suppliers must become an integral part of a design or project team. Timely submittal of complete, accurate, and user-friendly supporting materials, documentation, and manuals are crucial.

Even when building critical components in complex manufacturing systems or processes, *people skills count*. Fox is easy to work with. We are small enough to give you personalized attention, large enough to provide complex designs and systems, and we've been around long enough to supply

spares for equipment sold thirty years ago. We've been meeting the highest quality standards since the 1960's, and have been building flight hardware for spacecraft subject to government Source Inspection for almost 40 years.

If your project requires any of the following, we can provide outstanding engineering support:

- Fabrication and welding to ASME, B31.1, TEMA, AWS, and HEI.
- Weld Inspection
- Source /Fabrication Inspection
- Engineering/Consulting—from Concept to Start-up

## About Fox Valve...

Fox Valve Development Corp. was founded in 1961 to build high-performance venturi products for aerospace, industrial, and research applications. Fox's reputation in the 1960's as venturi specialists with superb in-house manufacturing attracted inquiries from diverse industries seeking highly engineered venturi solutions to their industry's specific applications. Our problem-solving skills, familiarity with exotic materials and processes, and manufacturing expertise led Fox into a broad range of industrial products all based on our one core technology—venturies. These product lines have helped Fox grow continuously and rapidly.

Our current major product lines summarized in Bulletin 051, include:

- Steam Jet Ejectors and Vacuum Systems
- Air Jet Ejectors and Mini-Ejectors
- Liquid, Tank-Mixing, and Slurry Ejectors
- Solids Conveying Ejectors
- Sonic Chokes, Cavitating and  $\Delta P$  Venturi Flowmeters

### Fox Process Representatives

Fox Valve Development Corp. is represented by a network of knowledgeable, engineering oriented representatives familiar with the operation of venturi jet equipment. Please call us to locate your local Fox representative.

## To receive a quote, please request our Application Data Sheet

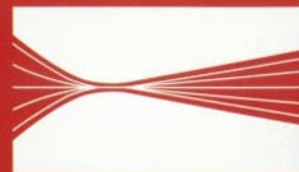
### ADDITIONAL TECHNICAL LITERATURE

The following materials are available upon request:

#### BULLETINS:

- 051—Fox Venturi Products—General Overview
- 101—Fox Liquid Ejectors
- 205—Fox Thermocompressors
- 261—Steam Tank Mixers and Pipeline Heaters
- 280—Air Jet Ejectors
- 301—Solids Conveying Venturi Ejectors

- 401—Mini-Ejectors
- 551—Corrosion-Resistant 'PLP' Ejectors
- 021—Fox Venturi Flow Controls
- 025—Sonic Chokes/Critical Flow Venturies



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# Application Data Sheet - *Steam Jet Vacuum Ejector*

Fox Venturi Ejectors from Fox Valve  
 Dover, NJ 07801 / [www.foxvalve.com](http://www.foxvalve.com)

Phone: (973) 328-1011 / Fax: (973) 328-3651 / E-Mail: [info@foxvalve.com](mailto:info@foxvalve.com)

Company Name: \_\_\_\_\_ Contact Name: \_\_\_\_\_

Company Address: \_\_\_\_\_

Phone: \_\_\_\_\_ Fax: \_\_\_\_\_ E-Mail: \_\_\_\_\_

### Motive Gas

Gas Type: Steam  
 Temp.: \_\_\_\_\_ °F  
 Pressure: \_\_\_\_\_ psig      Flow Rate: \_\_\_\_\_ lb/hr

### Suction Gas

Gas Type: \_\_\_\_\_  
 Molecular Weight: \_\_\_\_\_      Temp.: \_\_\_\_\_ °F

### What function will this ejector perform?

Continuous Operation - Venting or Exhausting

Suction Pressure: \_\_\_\_\_  psig     psia  
 Flow Rate: \_\_\_\_\_ lb/hr

Evacuating a Vessel or Pump Priming

Total Volume to be evacuated: \_\_\_\_\_ ft<sup>3</sup>  
 Final Pressure: \_\_\_\_\_  psig     psia  
 Evacuation Time: \_\_\_\_\_ min

### Discharge Conditions

Pressure: \_\_\_\_\_ psig

### Construction/End Connections:

Preferred End Connections:  NPT     Flanges - \_\_\_\_\_     Other: \_\_\_\_\_

Material of Construction:  Carbon Steel     Stainless Steel     PVC     Other: \_\_\_\_\_

Required Maximum Working Pressure: \_\_\_\_\_ psig    (*Stock ejectors have a MWP of 200 psig*)

Comments: \_\_\_\_\_

