

## Single stage steam ejectors

These include a wide variety of products including but not limited to:

- **Pre-evacuation ejectors** (priming and hogging ejectors )
- **Vacuum pumps** (for generation of low vacuum levels (as low as 100 mmHg) as required in low temperature boiling, vacuum filtering and cleaning or salt, sugar and milk evaporators)
- **Ventilators** (replacing fans for ventilation or low vacuum service exhausting)
- **Thermo-compressors** (used for heat recovery of low pressure process vapor)



## Multi-stage steam ejectors (with surface or direct contact condensers or both types (hybrid))

These are combination of multiple single stage ejectors in series, possibly with condenser stages in between to minimize steam consumption, to achieve higher vacuum levels:



- **2-stage systems** (down to 10 mmHg, vacuum distillation, evaporation and crystallization for chemical and refinery products, and in steam condensers for power generation)
- **3-stage systems** (down to 2 mmHg, steam jet chillers, stripping and deodorizing edible oils, etc, vacuum packaging)
- **4-stage systems** (down to 0.2 mmHg, freeze drying or dehydrating in food and pharmaceutical industry, electronic and high-tech applications)
- **5-stage systems** (down to 0.04 mmHg, electronic and high-tech applications and steel degassing)

## Liquid jet ejectors

Liquid jet ejectors utilize high pressure liquid to handle all kinds of mediums:

- **Liquid jet liquid pumps** (commonly used for proportioning chemical solutions, acid/alkali/lye dilution, etc, handling mediums such as suspensions or mud)
- **Liquid jet Solid pumps** (used for conveying granular solids, sand, gravel, semisolids such as crushable foodstuff and similar)

- **Liquid jet Gases ejectors**
  - **Liquid jet compressors** (commonly used in drinking water treatment, biological sewage treatment, lake rehabilitation, fish pond aeration, flare gas recovery and a wide variety of chemical applications)
  - **Liquid jet vacuum pumps** (used in start-up evacuation of suction pipelines of large centrifugal pumps and siphon lines and diverse chemical vacuum processes)
  - **Liquid jet ventilators** (replacing fans for ventilation or low vacuum service exhausting)
- **Vessel jet mixers** (commonly used in tank mixing, neutralization basins, sewage treatment plants)



### Steam jet liquid pumps

These devices are commonly used with either of two main purposes:

- **Heaters** (for installation in vessels and/or pipelines and noiseless injection of steam into the liquid)
- **Liquid pumps (siphon)** (for simultaneous conveying and heating of liquids)

### Gas jet ejectors

- **Gas jet compressors** (extensive applications in natural gas industry, flare gas recovery, etc)
- **Gas jet vacuum pumps** (dosing and sampling in nuclear industries, priming, leak oil or petrol collection, etc )
- **Gas jet ventilators** (replacing fans in air circulation, or ventilation applications)

### Standards

- HEI Standards for steam jet vacuum systems
- ASME Sec. VIII, Rules for construction of pressure vessels

### Construction materials

Ejectors can be made of a wide variety of materials including steal, stainless steel, cast iron, bronze, Teflon, PVC and graphite to suit the needs of any application and process.

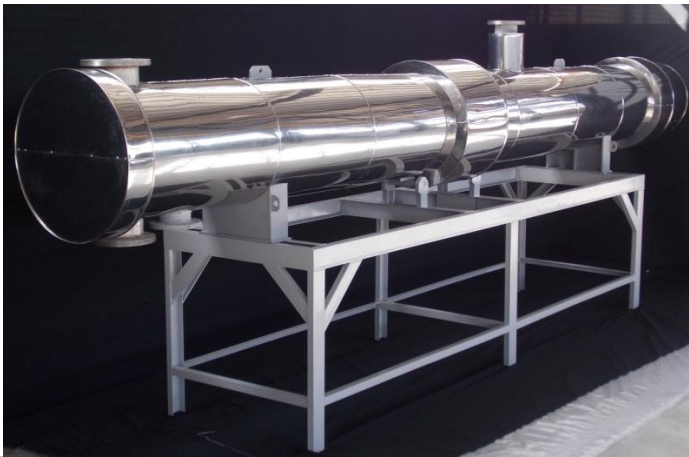


### Condensers

Condensers are typically used as inter-stages of multi-stage vacuum systems. They are also fabricated as single standing units to serve a variety of applications.

- **Surface (shell & tube) condensers** (used in applications where the condensing steam needs to be re-circulated after condensation and mixing with the cooling medium is not desired; common in power generation)

- **Direct contact condensers** (the cooling water is sprinkled directly over the condensing system; a barometric leg of around 10 m is necessary for drainage; typically used in vacuum systems serving the food industry; these are more economical options due to simple construction)
- **Jet condensers** (a direct contact condenser designed for simultaneous entrainment, condensation and discharging of (non-)condensable mixtures without need for extra vacuum system or barometric leg)



#### Standards

- HEI Standards for steam surface condensers
- Standards of the tubular exchanger manufacturers association (TEMA)
- ASME Sec. VIII, Rules for construction of pressure vessels

#### Construction materials

Condensers can be made of a wide variety of materials including carbon steel, stainless steel or brass for successful operation in the most severe corrosive environments such as sea water.

#### Silencers

EFFEK TECH noise control solutions are used to limit the noise level from a variety of equipment in many different industries. They are typically mounted on relief devices on steam turbines, boilers, start-up ejectors, compressors, etc, or on the intake/discharge of equipment producing high noise levels such as gas turbines. The silencers are custom designed to handle any kind of medium (CO<sub>2</sub>, steam, H<sub>2</sub>, combustion gases, etc) in any operating conditions without any limitations on capacity or construction materials.



- **Vent (blow down) silences** (used on relief devices and as the final point before discharging into atmosphere)
- **Inline silencers** (mounted on the inlet/outlet flow ports of the noise generating equipment such as ejectors)

### Steam jet chillers

Steam jet chillers are simple, economical and environmental friendly chillers providing refrigeration by creating a vacuum, by means of a multi-stage ejector system, thereby reducing the boiling point of water.

By using low pressure steam to create the required vacuum, steam jet chillers can utilize cooling water from conventional cooling towers and other sources. In general, any product having surface moisture can be cooled by evaporation, but the majority of installed steam jet chillers are used for cooling water.

The most outstanding features of these equipment include low noise, no moving parts, low maintenance, low operating cost (uses waste or low cost steam), high reliability, environmental friendliness (no refrigerant available), controllable cooling capacity and simple construction.



### Gas scrubbers

Jet scrubbers work on the ejector principle and are used to remove to delete gases, odors, particulates, dusts and fumes via absorption in or chemical reaction with the motive fluid. Scrubber units are equipped with a separator (gravitational or centrifugal), a storage tank and a circulation pump. Since the required draft is produced with the motive fluid, no fan or blower will be necessary. Some of the species handled by liquid jet gas scrubbers include  $\text{SO}_2$ ,  $\text{SO}_3$ ,  $\text{Cl}_2$ ,  $\text{SiF}_4$ ,  $\text{HCl}$ ,  $\text{NH}_3$ ,  $\text{HF}$ ,  $\text{H}_2\text{S}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{COCl}_2$ ,  $\text{HCN}$ ,  $\text{SOCl}_2$ ,  $\text{HBr}$ ,  $\text{Br}_2$ ,  $\text{F}_2$ , formaldehyde, reduced sulfur compounds, particulates, etc.

Depending on the specific process requirements, they may be constructed of any material to resist corrosion and erosion. Typical applications include, but are not limited to recovery of valuable materials, gas saturation and cooling, solids separation (de-dusting), cleaning flue gas flows, manufacture of chemical products, extracting and absorbing harmful gaseous substances from the surroundings.

### Static mixers

Static or motionless mixers are used for the continuous mixing of fluids. Normally the fluids to be mixed are liquid, but they can also be used to mix gas streams, disperse gas into liquid or blend immiscible liquids. The energy required for mixing comes from a loss in pressure as the fluids flow through the static mixer. Typical applications include mixing of molten polymers, blending oil streams, gas dispersion into liquids and concrete mixing. The following are among the most common types of static mixers:

- **Radial mixer elements**
- **Two-by-two division elements**
- **Cross-current mixer elements**
- **Counter-rotating vortex elements**
- **Helical mixer elements**
- **Low pressure drop mixer elements**

## **De-superheater**

Direct contact de-superheaters in which water is added directly to the superheated steam are widely used where dry steam with temperature lower than already available is desired for an application. Typically, they are used in thermal power plants, cogeneration plants (in boiler steam, turbine by-pass, attemperator, HRSG (heat recovery steam generation)), refineries and in production of fertilizers, petrochemicals, pharmaceuticals, sugar, pulp and paper, steel, etc.

There are different types of direct contact desuperheaters each suitable for a specific duty:

- **Water spray desuperheaters**
- **Venturi type desuperheaters**
- **Ejector atomizer desuperheaters**
- **Surface absorption desuperheaters**

Our motionless mixer elements are being used in numerous of processing applications as following:

- 1- **Helical elements** : these elements are perfectly appropriate for laminar or turbulent mixing/blending with high viscosity and high or low turbulence. They can disperse two immiscible liquids or gases into turbulent liquids.
- 2- **Elliptical Elements**: These elements are more applied for mixing/blending of viscous flows. Furthermore they can be used in some laminar flows.
- 3- **Corrugated plates-type elements**: These elements are applicable for mixing/blending of turbulent flows and are best design alternatives for liquid-liquid or gas-liquid dispersion. They are specifically attractive design options for turbulent flow applications in large diameter pipes where mixing length is limited.
- 4- **Lattice elements**: These elements can be used for high viscosity liquids as well as liquids with extremely diverse viscosities especially for laminar flows.

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- **Venturi type**
- **Ejector atomizer**

## Static mixers

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- **Elliptical Elements**
- **Corrugated plates**
- **Lattice elements**

## Applications

### Single stage steam ejectors

|   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• <b>Pre-evacuation ejectors</b></li> <li>• <b>Vacuum pumps</b></li> </ul> | <ul style="list-style-type: none"> <li>○ Priming and hogging ejectors</li> <li>○ Low temperature boiling</li> <li>○ Vacuum filtering and cleaning</li> <li>○ Salt, sugar and milk evaporators</li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>Ventilators</b></li> <li>• <b>Thermo-compressors</b></li> </ul>       | <ul style="list-style-type: none"> <li>○ Replacing fans for ventilation or low vacuum service exhausting</li> <li>○ Heat recovery of low pressure process vapor</li> </ul>                               |

### Multi-stage steam ejectors (with surface or direct contact condensers or both types (hybrid))

|  |  |
|--|--|
| <ul style="list-style-type: none"> <li>• <b>2-stage systems</b></li> </ul> | <ul style="list-style-type: none"> <li>○ Vacuum distillation, evaporation and crystallization for chemical and refinery products</li> <li>○ Steam condensers for power generation</li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>3-stage systems</b></li> </ul> | <ul style="list-style-type: none"> <li>○ Steam jet chillers</li> <li>○ Stripping and deodorizing edible oils, etc</li> <li>○ Vacuum packaging</li> </ul>                                     |
| <ul style="list-style-type: none"> <li>• <b>4-stage systems</b></li> </ul> | <ul style="list-style-type: none"> <li>○ Freeze drying or dehydrating in food and pharmaceutical industry</li> <li>○ Electronic and high-tech applications</li> </ul>                        |
| <ul style="list-style-type: none"> <li>• <b>5-stage systems</b></li> </ul> | <ul style="list-style-type: none"> <li>○ Electronic and high-tech applications</li> <li>○ Steel degassing</li> </ul>   |

### Liquid jet ejectors

|  |  |
|--|--|
| <ul style="list-style-type: none"> <li>• <b>Liquid jet liquid</b></li> </ul>   | <ul style="list-style-type: none"> <li>○ Proportioning chemical solutions</li> <li>○ Acid/alkali/lye dilution</li> <li>○ Handling mediums such as suspensions or mud</li> </ul>  |
| <ul style="list-style-type: none"> <li>• <b>Liquid jet Solid</b></li> <li>• <b>Liquid jet compressors</b></li> </ul> | <ul style="list-style-type: none"> <li>○ Conveying granular solids, sand, gravel, semisolids such as crushable foodstuff, etc</li> <li>○ Drinking water and biological sewage treatment</li> <li>○ Lake rehabilitation</li> <li>○ Fish pond aeration</li> <li>○ Flare gas recovery</li> <li>○ Wide variety of chemical applications</li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>Liquid jet vacuum pumps</b></li> </ul>                                   | <ul style="list-style-type: none"> <li>○ Start-up evacuation of suction pipelines of large centrifugal pumps and siphon lines</li> <li>○ Diverse chemical vacuum processes</li> </ul>  |
| <ul style="list-style-type: none"> <li>• <b>Liquid jet ventilators</b></li> </ul>                                    | <ul style="list-style-type: none"> <li>○ Replacing fans for ventilation or low vacuum service exhausting</li> </ul>  |
| <ul style="list-style-type: none"> <li>• <b>Vessel jet mixers</b></li> </ul>   | <ul style="list-style-type: none"> <li>○ Tank mixing</li> <li>○ Neutralization basins</li> <li>○ Sewage treatment plants</li> </ul>  |

### Steam jet liquid pumps

|  |  |
|--|--|
| <ul style="list-style-type: none"> <li>• <b>Heaters</b></li> <li>• <b>Liquid pumps (siphon)</b></li> </ul> | <ul style="list-style-type: none"> <li>○ Installation in vessels and/or pipelines and noiseless injection of steam into the liquid</li> <li>○ Simultaneous conveying and heating of liquids</li> </ul> |
|--|--|

### Gas jet ejectors

|   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• <b>Gas jet compressors</b></li> <li>• <b>Gas jet vacuum pumps</b></li> </ul> | <ul style="list-style-type: none"> <li>○ Extensive applications in natural gas industry, flare gas recovery, etc</li> <li>○ Dosing and sampling in nuclear industries</li> <li>○ Priming, leak oil or petrol collection</li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>Gas jet ventilators</b></li> </ul>  | <ul style="list-style-type: none"> <li>○ Replacing fans in air circulation, or ventilation applications</li> </ul>   |

### Condensers

|  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• <b>Surface (shell &amp; tube) condensers</b></li> </ul> | <ul style="list-style-type: none"> <li>○ Power generation</li> <li>○ Where the condensing steam needs to be re-circulated after condensation and mixing with the cooling medium is not desired</li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>Direct contact condensers</b></li> </ul>             | <ul style="list-style-type: none"> <li>○ Vacuum systems serving the food industry</li> </ul>  |
| <ul style="list-style-type: none"> <li>• <b>Jet condensers</b></li> </ul>                        |   |

### Silencers

|  |  |
|--|--|
| <ul style="list-style-type: none"> <li>• <b>Vent (blow down) silences</b></li> </ul> | <ul style="list-style-type: none"> <li>○ mounted on relief devices on steam turbines, boilers, start-up ejectors, compressors, etc</li> <li>○ Gas turbine exhaust</li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>Inline silencers</b></li> </ul>          | <ul style="list-style-type: none"> <li>○ mounted on the inlet/outlet flow ports of the noise generating equipment such as ejectors</li> </ul>                                |

### Gas scrubbers

- Recovery of valuable materials
- Gas saturation and cooling
- Solids separation (de-dusting)
- Cleaning flue gas flows, manufacture of chemical products
- Extracting and absorbing harmful gaseous substances from the surroundings

### Static mixer

- Mixing of molten polymers
- Blending oil streams
- Gas dispersion into liquids
- Concrete mixing

### De-superheater

- Thermal power plants
- Cogeneration plants
- Boiler steam attemperator
- Turbine by-pass attemperator
- HRSG (heat recovery steam generation)
- Refineries services
- Fertilizers, petrochemicals, pharmaceuticals, sugar, pulp and paper, steel, etc production