



# Ejector Technical Document

## Ejector Selection

The ejector is a crucial piece of equipment for proper operation of a vacuum gas feed system. The system as a whole cannot operate if the ejector does not function. This technical bulletin will provide important information on ejector selection and system design. This document will mention water operated chlorine gas ejectors for simplicity, but ejectors can be operated by air or Nitrogen and various gas and ejectors can be used to inject various gas and liquid chemicals.

### Ejector Overview

#### Function

An ejector has several very important functions within the gas feed system. It needs to generate the operating vacuum, create the chlorine solution, and prevent the back flow of water into the vacuum lines.

**Operating Vacuum**—Hydro Instruments' ejectors are designed to generate a vacuum of 25" mercury (Hg) or greater and generate sufficient suction to achieve the stated feed rate. Inadequate vacuum can produce unreliable gas feed.

**Chlorine Solution**—The ejector is where the chemical is injected into the water stream.

**Back Flow Prevention**—A check valve prevents back flow of water during shut down.

#### Operation

A vacuum of 25" Hg or greater is generated by supply water passing through the ejectors venturi nozzle. As the supply water under high pressure is passed through a small orifice its velocity increases resulting in a drop in pressure. By creating an adequate pressure differential ( $\Delta P$ ) of water between the ejector inlet (supply pressure,  $P_{\text{supply}}$ ) and the ejector outlet, this pressure drop becomes great enough to create a vacuum and draw the feed chemical through the system and into the water stream. If this pressure differential is not maintained, an insufficient vacuum will be produced or no vacuum at all.

#### Design

Hydro Instruments' ejectors consist of the following common components:

- Water inlet & solution outlet
- One piece nozzle or nozzle/throat combination
- Vacuum connection for gas inlet
- Check valve

The one piece nozzle for smaller 3/4" ejectors and nozzle/throat combinations for larger 1-1/4" and high capacity ejectors are specific to the gas feed rate and the available hydraulics.

All Hydro Instruments' ejectors have an integral check valve to prevent process water from entering the gas feed systems piping and equipment while the system is idle. Some high capacity ejectors also incorporate a drain valve in the event the primary check valve fails.

#### Hydraulics

The combined pressure at the point of application and piping friction loss is known as the back pressure. A higher back pressure requires a higher ejector inlet pressure and more supply water to make the ejector function correctly.

Hydraulic operation curves have been developed to assist with system design. These curves specify minimum supply pressures and flow rates to be supplied to the ejector against a given back pressure.

Supply Pressure	The water pressure that exists at the inlet of the ejector.
Back Pressure	The pressure that exists at the outlet of the ejector.
Friction Loss	The pressure drop due to friction within the water pipe line; both the supply line and solution line.
Water Flow Rate	The flow rate of water supplied to the ejector expressed in gallons per minute (GPM) or cubic meters per hour (M3/HR) etc...



600 Emlen Way, Telford, PA 18969 ● Telephone: (215) 799-0980 ● Fax: (215) 799-0984

US Toll Free: (888) 38-HYDRO ● [www.hydroinstruments.com](http://www.hydroinstruments.com) ● [sales@hydroinstruments.com](mailto:sales@hydroinstruments.com)

## Ejector Selection

Hydro Instruments offers a wide range of ejectors to meet individual application needs.

Choosing the right ejector is very important for proper and reliable operation of the gas feed system. Should the wrong ejector be chosen, problematic system operation and unwanted downtime can be the result.

Ejectors for specific applications (e.g. variable orifice, anti-siphon and diaphragm-less) can enhance performance, safety and/or minimize maintenance requirements.

### **Standard 3/4" and 1-1/4" Ejectors**

These ejectors are general purpose ejectors recommended for most applications. Several different designs are available for a wide range of capacities. See Table 1 for additional information.

#### **Feed Capacity:**

Up to 100 PPD Cl<sub>2</sub> (2.4 Kg/h) for 3/4" ejectors

Up to 600 PPD Cl<sub>2</sub> (12 Kg/h) for 1-1/4" ejectors

#### **Maximum Back Pressure:**

145 PSI (10 bar) for standard models

250 PSI (17.2 bar) for ejectors with body plates

### **Anti-Siphon Ejectors**

Anti-siphon ejectors are primarily used in systems where the ejectors water supply being shut off presents the possibility of causing a negative head (i.e. siphon) at the point of application. For example, if the ejector solution line or water main drains when the ejector supply water is shut off.

The siphon will cause the vacuum regulator in the gas feed system to continue to operate, allowing gas to be fed directly into the water piping system. Hydro Instruments' anti-siphon ejectors are outfitted with an anti-siphon valve and specially designed ejector nozzle to break the siphon and prevent chemical from unintentionally being drawn into the piping.

#### **Feed Capacity:**

Up to 100 PPD Cl<sub>2</sub> (2.4 Kg/h) for 3/4" anti-siphon ejectors

Up to 600 PPD Cl<sub>2</sub> (12 Kg/h) for 1-1/4" anti-siphon ejectors

Up to 2,000 PPD Cl<sub>2</sub> (40 Kg/h) for 2" anti-siphon ejectors

#### **Maximum Back Pressure:**

145 PSI (10 bar) for 3/4" and 1-1/4" anti-siphon ejectors

250 PSI (17.2 bar) for 3/4" and 1-1/4" anti-siphon ejectors with body plates

100 PSI (6.9 bar) for 2" anti-siphon ejectors

### **Diaphragmless Ejectors**

Diaphragmless ejectors are primarily used in application with a high back pressure and/or for system with frequent on/off cycling that would stress an ejector with a rubber diaphragm.

The diaphragmless ejector incorporates a spring-loaded check valve that functions without the use of a rubber diaphragm. Vacuum opens the check valve and an absence of vacuum allows the spring combined with water pressure to close the check valve.

#### **Feed Capacity:**

Up to 100 PPD Cl<sub>2</sub> (2.4 Kg/h) for 3/4" ejectors

Up to 600 PPD Cl<sub>2</sub> (12 Kg/h) for 1-1/4" ejectors

#### **Maximum Back Pressure:**

15-145 PSI (10 bar) for standard models

15-250 PSI (17.2 bar) for ejectors with body plates

15-300 PSI (20.7 bar) for EJH-143-CL2-HP high pressure ejector

### **High Capacity Fixed Orifice Ejectors**

Fixed orifice ejectors are general purpose ejectors recommended for most applications. Several different designs are available for a wide range of capacities. See Table 2 for additional information.

**Feed Capacity:**

Up to 2,000 PPD Cl<sub>2</sub> (40 Kg/h) for 2" ejectors  
Up to 10,000 PPD Cl<sub>2</sub> (200 Kg/h) for 3" ejectors  
Up to 10,000 PPD Cl<sub>2</sub> (200 Kg/h) for 4" ejectors

**Maximum Back Pressure:**

100 PSI (6.9 bar)

### **High Capacity Variable Orifice Ejectors**

Variable orifice ejectors are used primarily where a wide range of gas feed rates are needed. These ejectors allow external, manual adjustment of the nozzle orifice size to increase or decrease ejector capacity, minimize water usage and thereby minimize power consumption of booster pumps.

**Feed Capacity:**

Up to 2,000 PPD Cl<sub>2</sub> (40 Kg/h) for 2" ejectors  
Up to 10,000 PPD Cl<sub>2</sub> (200 Kg/h) for 3" ejectors  
Up to 10,000 PPD Cl<sub>2</sub> (200 Kg/h) for 4" ejectors

**Maximum Back Pressure:**

100 PSI (6.9 bar)

### **High Capacity Enhanced Performance Ejectors**

Hydro Instruments' line of high capacity, enhanced performance ejectors are able to feed chemical with less supply pressure and water usage, thereby also reducing power consumption of booster pumps. These ejectors use an integral spring-less check valve to prevent vacuum reduction to the gas feed system and external drain valve to more reliably keep vacuum lines and equipment free of water.

**Feed Capacity:**

Up to 2,000 PPD Cl<sub>2</sub> (40 Kg/h) for 2" ejectors  
Up to 10,000 PPD Cl<sub>2</sub> (200 Kg/h) for 3" ejectors

**Maximum Back Pressure:**

100 PSI (6.9 bar)

### **Chlorine Dioxide Ejectors (ClO<sub>2</sub>)**

Hydro Instruments' chlorine dioxide ejectors are designed with three vacuum connections to draw multiple chemicals into a mixing chamber before being drawn into the water stream. The process wetted parts are made from CPVC to withstand the high temperatures generated with this chemical injection process.

**Feed Capacity:**

Up to 28 GPH ClO<sub>2</sub> for 3/4" ejectors  
Up to 120 GPH ClO<sub>2</sub> for 1-1/4" ejectors

**Maximum Back Pressure:**

145 PSI (10 bar)

## **Ejector Nozzle Selection**

For each ejector there are several nozzle or nozzle/throat combinations available. Nozzle/throat combinations must be selected appropriately for the desired chemical feed rate capacity.

The information needed to select the proper ejector nozzle or nozzle/throat combination is:

1. Maximum capacity of the gas/liquid feed system.
2. Supply pressure available to the ejector.
3. Supply water flow rate available to the ejector.
4. Back pressure at the outlet of the ejector.

**TABLE 1**

	<b>Standard 3/4" and 1-1/4" Ejectors</b>	<b>Anti-siphon</b>	<b>Diaphragmless</b>	<b>Chlorine Dioxide (ClO<sub>2</sub>)</b>
Application	General purpose	Where a negative head at the application point could exist.	Systems with frequent on/off cycling and/or with very high back pressure	One, two or three chemicals for chlorine dioxide generation and injection.
Capacity	Up to 100 PPD Cl <sub>2</sub> (2.4 Kg/h) for 3/4" ejectors Up to 600 PPD Cl <sub>2</sub> (12 Kg/h) for 1-1/4" ejectors	Up to 100 PPD Cl <sub>2</sub> (2.4 Kg/h) for 3/4" ejectors Up to 600 PPD Cl <sub>2</sub> (12 Kg/h) for 1-1/4" ejectors Up to 2,000 PPD Cl <sub>2</sub> (40 Kg/h) for 2" ejectors	Up to 100 PPD Cl <sub>2</sub> (2.4 Kg/h) for 3/4" ejectors Up to 600 PPD Cl <sub>2</sub> (12 Kg/h) for 1-1/4" ejectors	Up to 28 GPH ClO <sub>2</sub> for 3/4" ejectors Up to 120 GPH ClO <sub>2</sub> for 1-1/4" ejectors
Max. Back Pressure	145 PSI (10 bar) 250 PSI (17.2 bar) for ejectors with body plates	145 PSI (10.2 bar) 250 PSI (17.2 bar) for ejectors with body plates 100 PSI (6.9 bar) for 2" ejectors	15-145 PSI (10 bar) 15-250 PSI (17.2 bar) for ejectors with body plates 15-300 PSI (20.7 bar) for EJH-143-CL2-HP high pressure ejector	145 PSI (10 bar)
Check Valve Type	Diaphragm w/ Self centering O-Ring, O-Ring or Gasket	Diaphragm w/ Self centering O-Ring for 3/4" ejectors Diaphragm w/ O-Ring	Check-bolt w/ O-Ring	Diaphragm w/ O-Ring
Available for:	Cl <sub>2</sub> , SO <sub>2</sub> , NH <sub>3</sub> , CO <sub>2</sub>	Cl <sub>2</sub> , SO <sub>2</sub> , CO <sub>2</sub>	Cl <sub>2</sub> , SO <sub>2</sub> , CO <sub>2</sub>	ClO <sub>2</sub>

**TABLE 2**

	<b>High Capacity Fixed Orifice</b>	<b>High Capacity Variable Orifice</b>	<b>High Capacity Enhanced Performance</b>
Application	General purpose	Where a wide range of gas feed rates are needed	General purpose Systems with less supply pressure and/or less supply water
Capacity	Up to 2,000 PPD Cl <sub>2</sub> (40 Kg/h) for 2" ejectors Up to 10,000 PPD Cl <sub>2</sub> (200 Kg/h) for 3" ejectors Up to 10,000 PPD Cl <sub>2</sub> (200 Kg/h) for 4" ejectors	Up to 2,000 PPD Cl <sub>2</sub> (40 Kg/h) for 2" ejectors Up to 10,000 PPD Cl <sub>2</sub> (200 Kg/h) for 3" ejectors Up to 10,000 PPD Cl <sub>2</sub> (200 Kg/h) for 4" ejectors	Up to 2,000 PPD Cl <sub>2</sub> (40 Kg/h) for 2" ejectors Up to 10,000 PPD Cl <sub>2</sub> (200 Kg/h) for 3" ejectors
Max. Back Pressure	100 PSI (6.9 bar)	100 PSI (6.9 bar)	100 PSI (6.9 bar)
Check Valve Type	Diaphragm w/ O-Ring	Diaphragm w/ O-Ring	Check-ball w/ O-Ring & Drain valve
Available for:	Cl <sub>2</sub> , SO <sub>2</sub> , NH <sub>3</sub> , CO <sub>2</sub>	Cl <sub>2</sub> , SO <sub>2</sub> , CO <sub>2</sub>	Cl <sub>2</sub> , SO <sub>2</sub> , CO <sub>2</sub>

**FIGURE 1**

