8/25/2022

Chlorine Overview

Hawkins Water Treatment Group

Me and My Role in Hawkins

- Graduated from Kansas State University in 2019.
  - B.A. in Industrial Engineering.
- Started with Hawkins may of 2021.
- Job Title is Project manager.
- I specifically work with the chemical feed equipment.

Agenda

- Chlorine
- Types of Chlorine
- Gas Feed
- Liquid Feed

Chlorine Disinfection

- Chlorine kills pathogens such as bacteria and viruses by breaking the chemical bonds in their molecules. Disinfectants that are used for this purpose consist of chlorine compounds which can exchange atoms with other compounds, such as enzymes in bacteria and other cells.

CHLORINE GAS

Properties:

- 100% Active
- Compressed Liquefied Gas
- 2.5 Times Heavier Than Air
- Boiling Point: -30° F (Liquid to Gas)
- Freeze Point: -150° F
- 1 Volume Liquid = 460 Volumes Air

Sodium Hypochlorite

Properties:

Light Yellow Solution

Freeze Point: -15° F

10 LBS./Gallon

12.5% Active

11.5 pH

Calcium Hypochlorite

Properties:

- White Granular or Tablet
- 65% Active
- 10.4-10.8 pH (1% Solution)
- 18% Soluble in Water @ 77° F

HOW DOES A VACUUM FEED GAS CHLORINATION SYSTEM WORK?

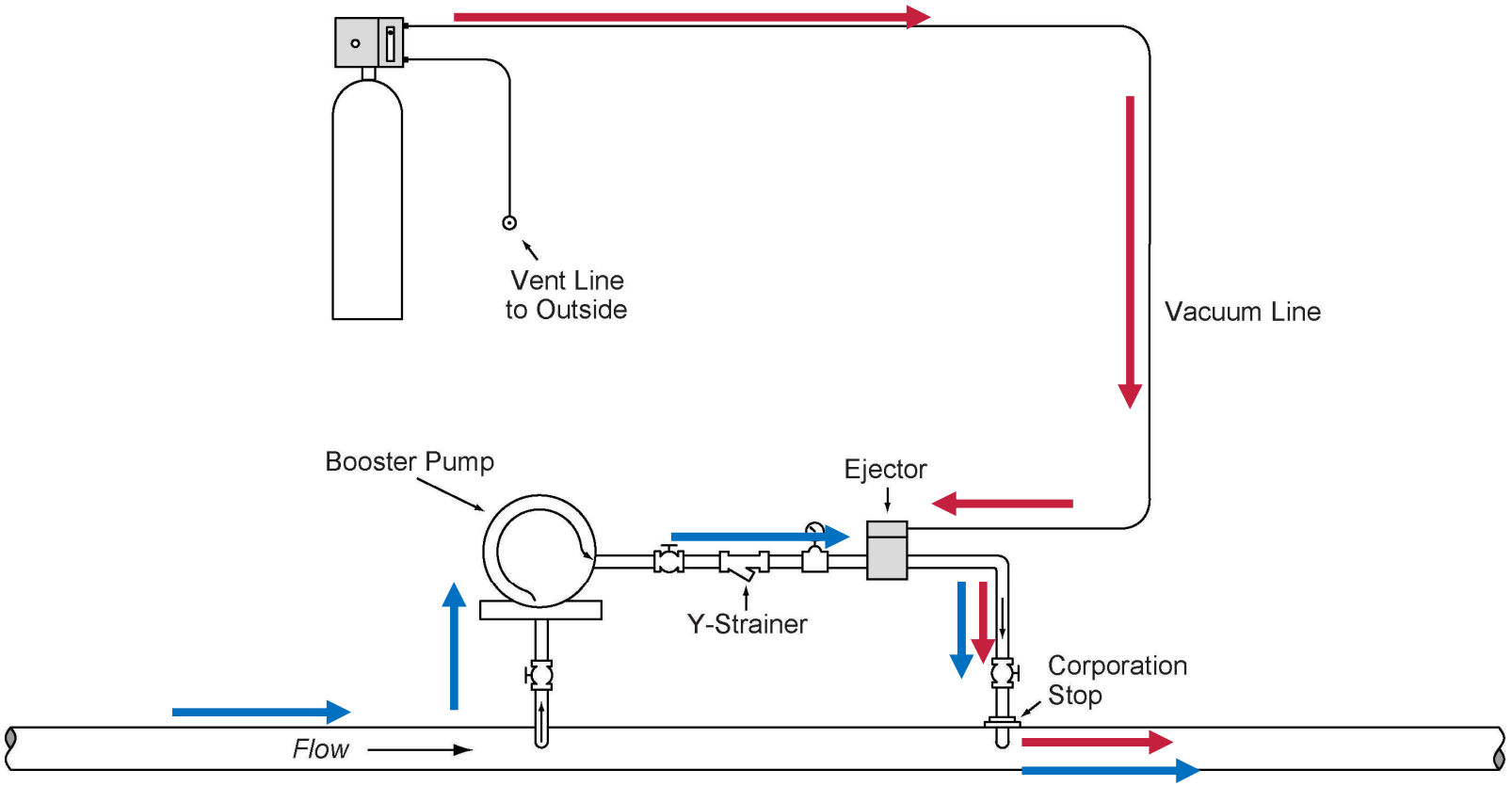
Consider what the system is meant to do:

Safely meter a controllable rate of gaseous Chlorine from a pressurized cylinder into a stream of water.

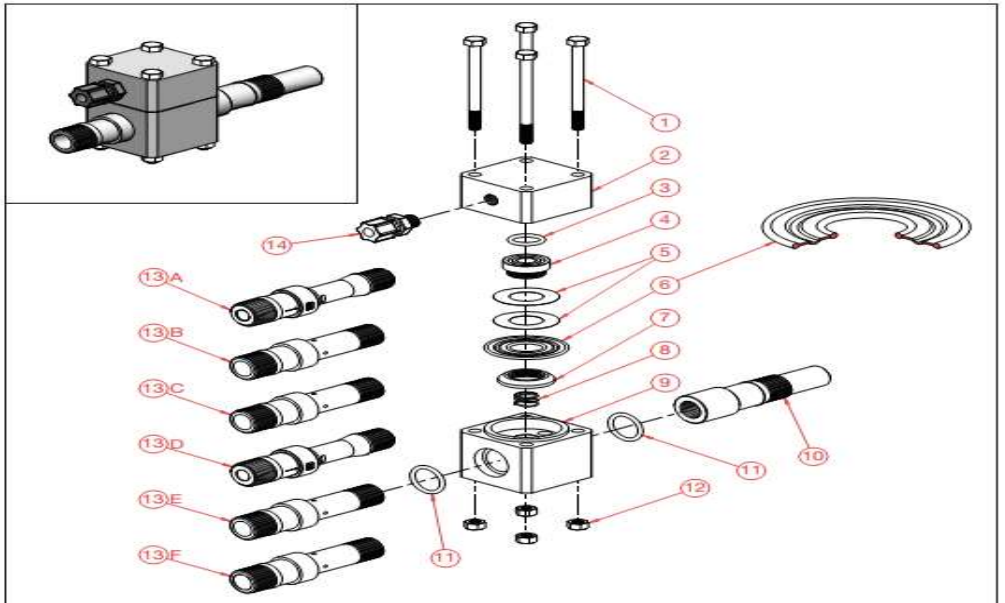
Note: The pressurized Chlorine is in a liquid form (in the cylinder). As vapors are drawn from the top of the cylinder, the Chlorine evaporates.

So, …How Do We Do This?

CHLORINE VACUUM SYSTEM HOW IT WORKS



VACUUM EJECTOR



Item No.	Description	Quantity	Part No.
1	5/16-18 x 4" Bolt	4	BTH-STA-136
2	Top Body	1	EJH-237-250
3	PM O-Ring	1	OH-CEM-210
4	PM Diaphragm Bolt	1	EJH-236-500
5	PM Set of Two Support Diaphragms	1	DIH-105-500
6	PM Diaphragm	1	DIH-104-500
7	PM Diaphragm Nut	1	EJH-146-500
8	Spring	1	SPH-106-000
9	Bottom Body	1	EJH-153-500
10	Multi Purpose Diffuser	1	EJH-982-100
11	PM O-Ring	2	OH-VIT-214
12	5/16-18 Nut	4	NTH-STA-104

Item No.	Description	Quantity	Part No.
13 A	* Nozzle (50 PPD max.)	1	UN-102-099D
13 B	* Nozzle (25 PPD max.)	1	CNH-016-106
13 C	* Nozzle (50 PPD max.)	1	CNH-013-128
13 D	* Nozzle (100 PPD max.)	1	UN-102-140
13 E	* Nozzle (100 PPD max.)	1	CNH-015-156
13 F	* Nozzle (100 PPD max.)	1	CNH-012-191
14	PM 3/8" Tubing Connector	1	BKF-64
PM	Part and Maintenance Kit	1	KTH-100-EJO
*	Refer to nozzle sizing charts for correct sizing.		

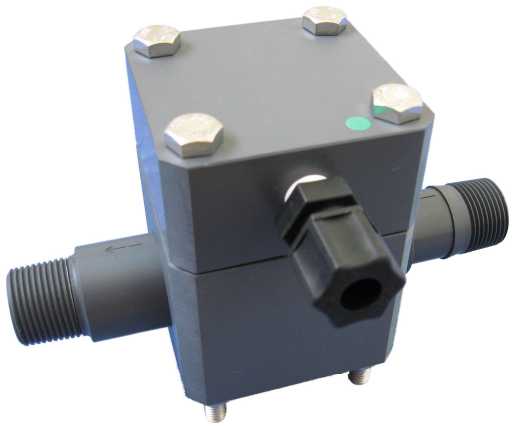
EJECTOR (O-RING)

Date: April 2017
EXPLODED VIEW AND BOM
Dwg. No. EJO-100-CL2

IT ALL STARTS WITH THE EJECTOR

- Decades ago, the idea of drawing the gaseous chlorine into the water under vacuum became recognized as a much safer method of delivery than feeding the gas under pressure.

The Ejector creates the vacuum by use of a Venturi nozzle. The Venturi vacuum is caused by a restriction in air pressure that is caused when air or fluid flows passes through a choked or constricted section of a pipe. Venturi vacuums generate vacuums by utilizing a Venturi chamber meant to move fluids or gases via a narrow section of a pipe.

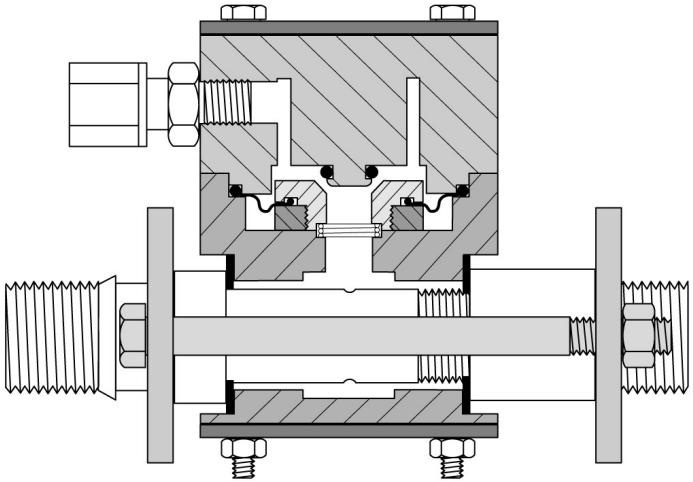


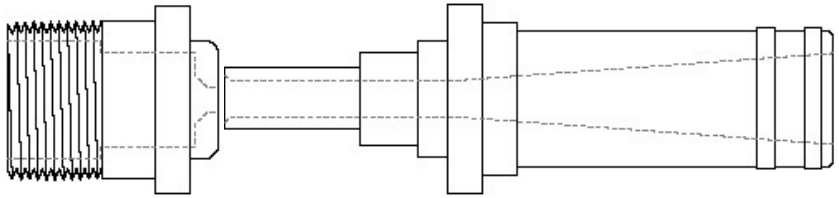
FUNCTIONS OF THE EJECTOR

-Creates the vacuum which draws the gas

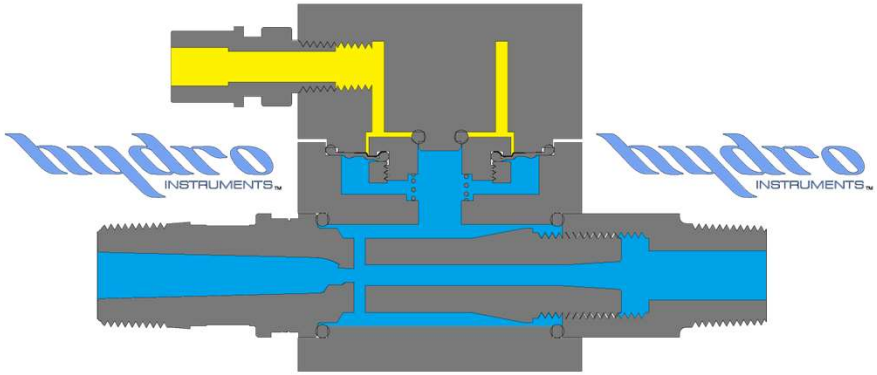
-Mixes the gas with the process water

-Prevents back-flooding of the chlorination equipment with an internal check valve

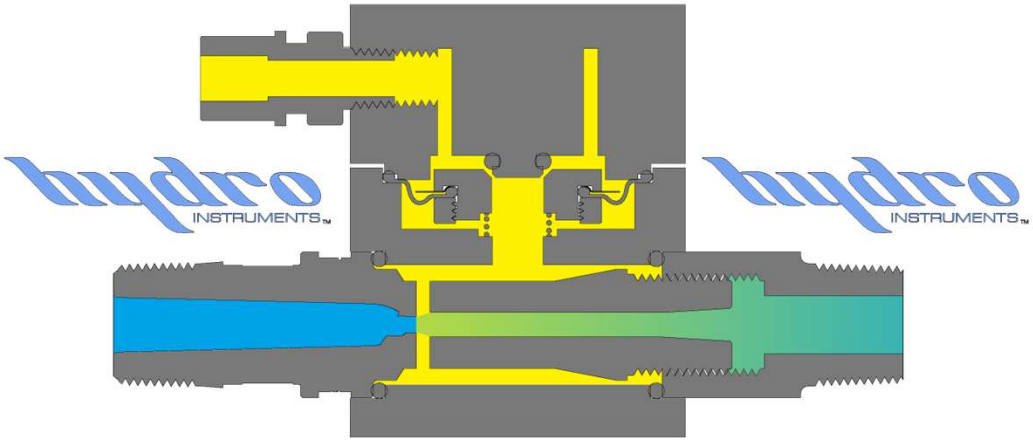




CHECK VALVE CLOSED



CHECK VALVE OPENED



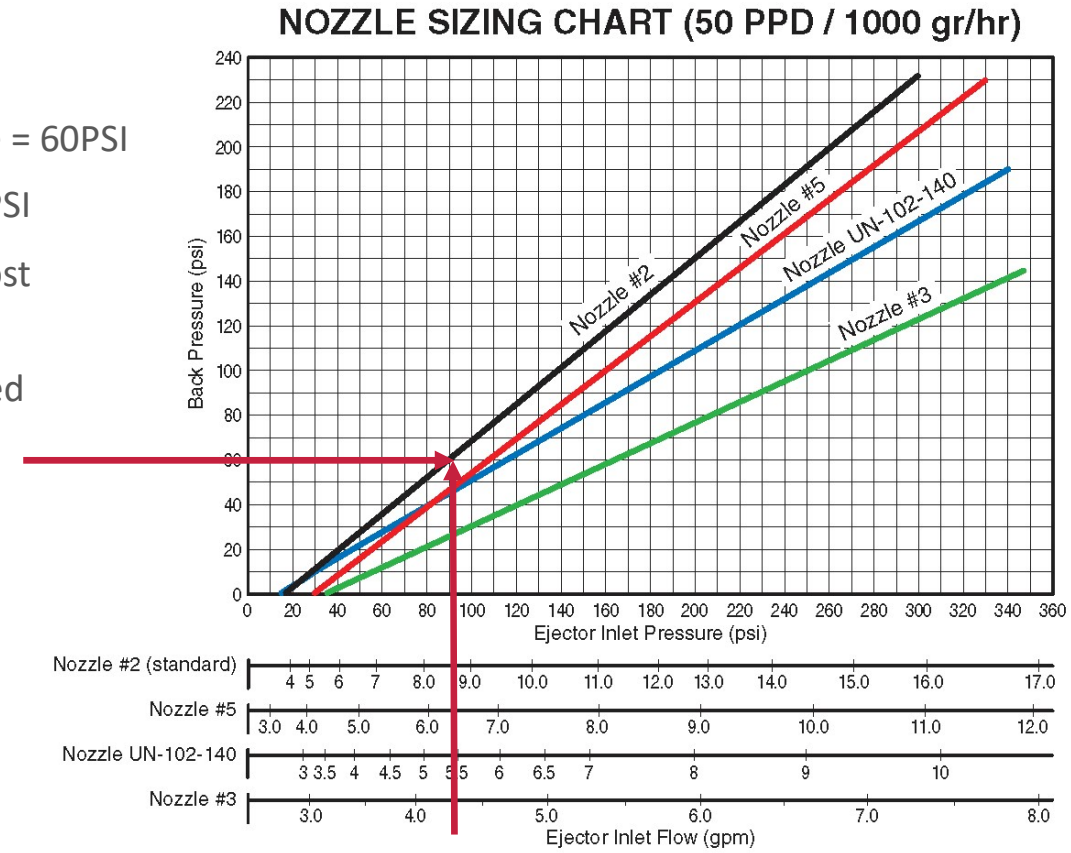
EJECTOR NOZZLE CHART

Water Supply Back Pressure = 60PSI

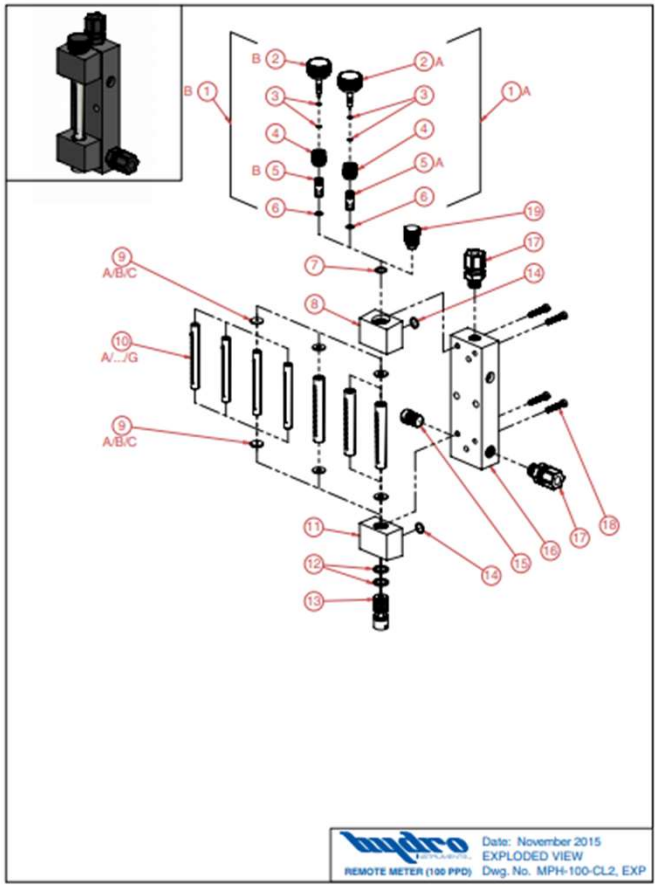
Ejector Inlet Pressure = 90PSI

90 PSI – 60 PSI = 30 PSI Boost Required

Flow rate of 9 GPM Required



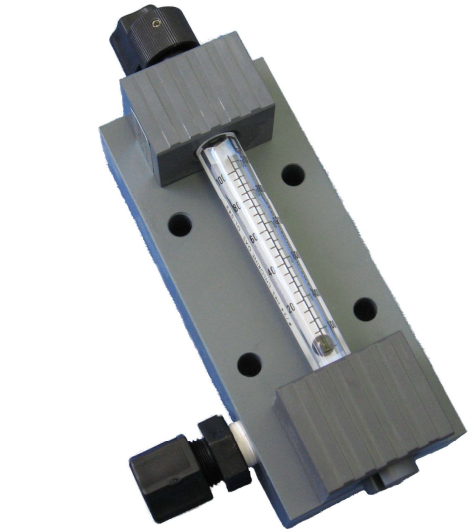
REMOTE METER PANEL (ROTOMETER)



CONTROLLING THE GAS FEED RATE

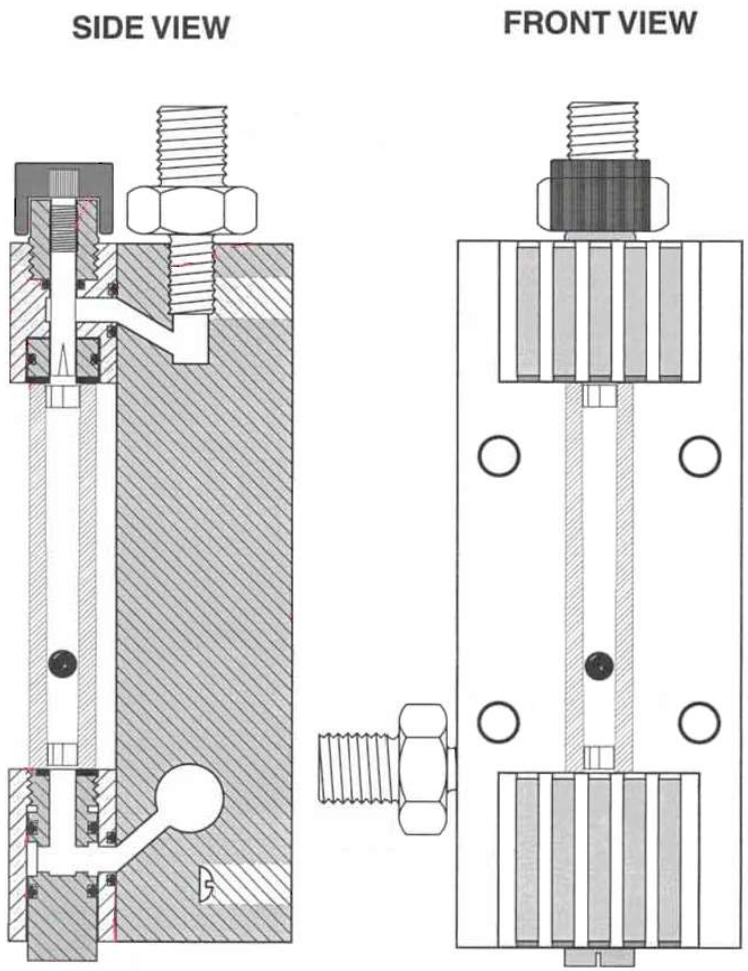
-By placing a small valve between the ejector and the inlet valve, the vacuum level (and therefore the withdraw rate) can be controlled.

- We call this the rate valve



REMOTE METER PANEL

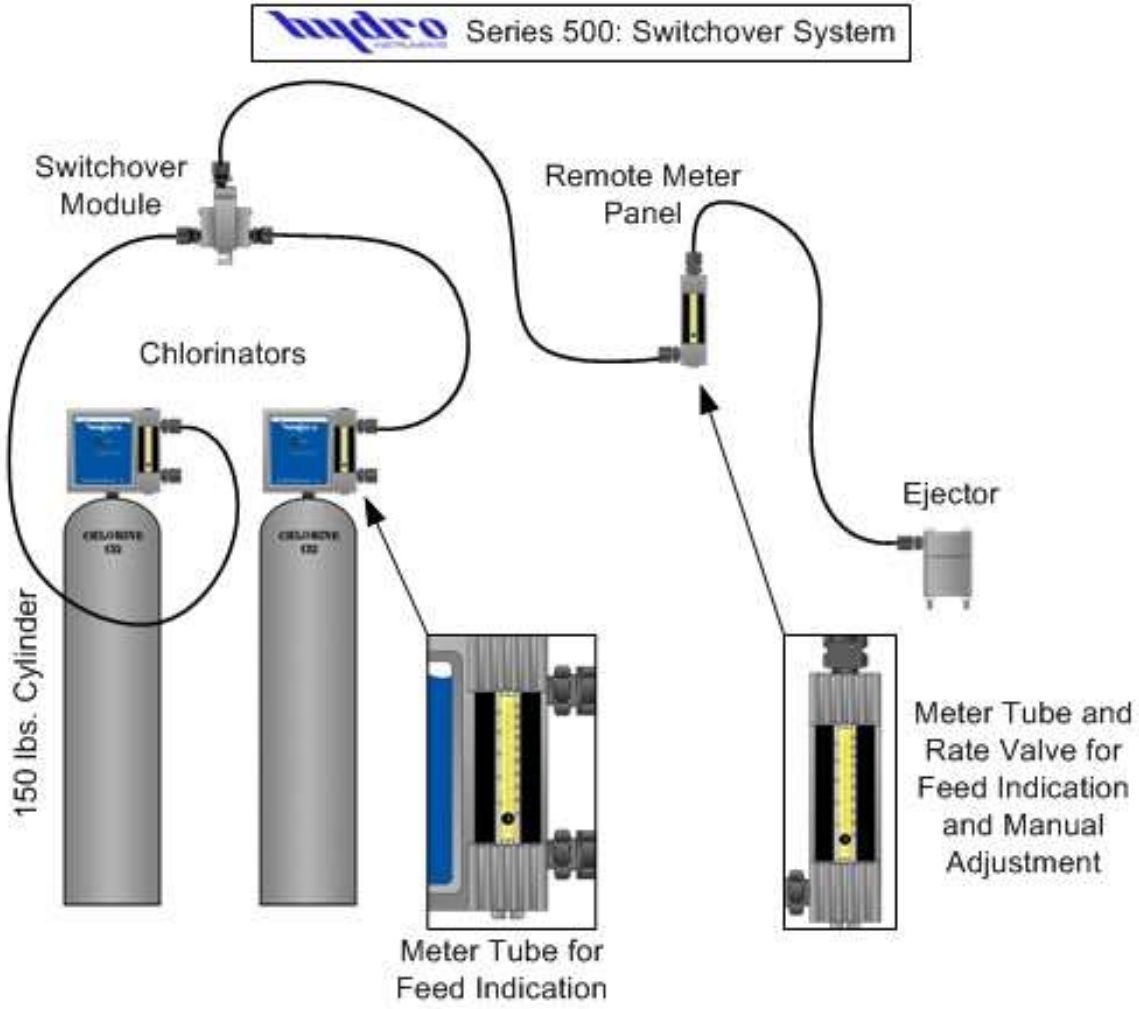
-Although the rate valve can be incorporated into most Vacuum Regulators, it is more commonly a separate component

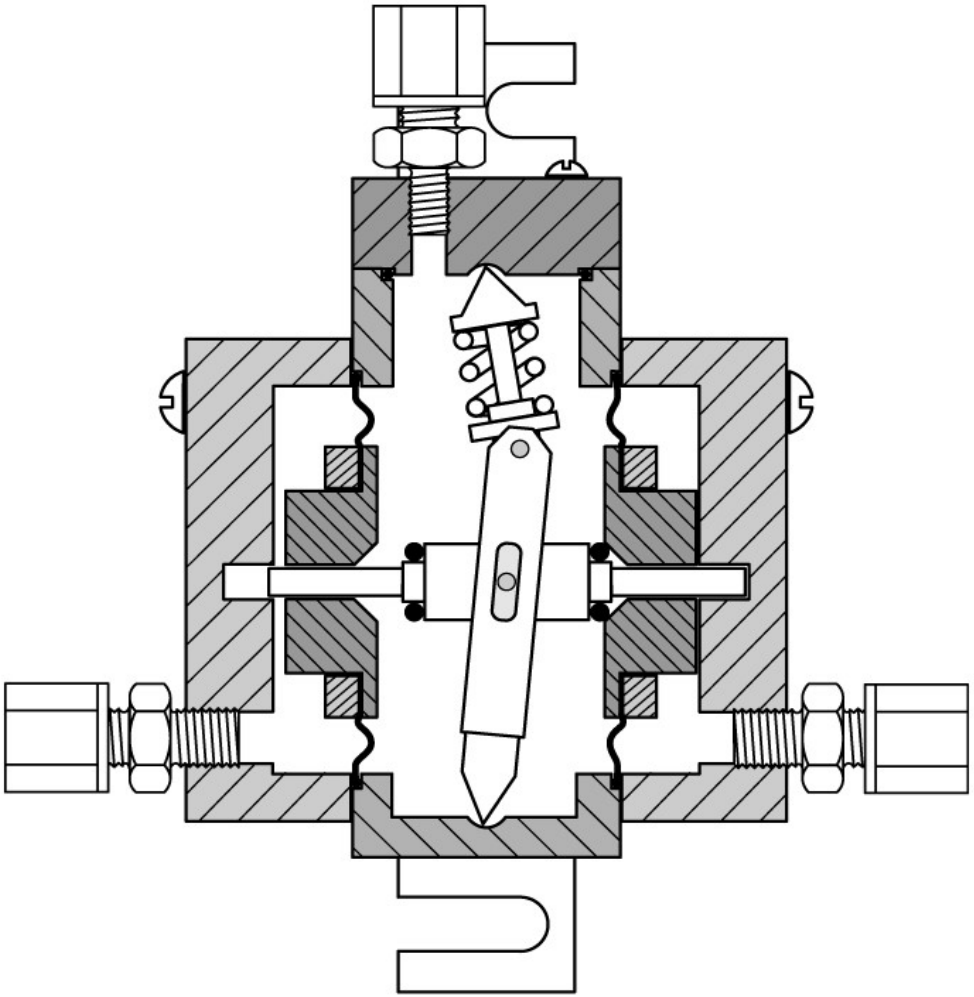


AUTOMATIC SWITCHOVER

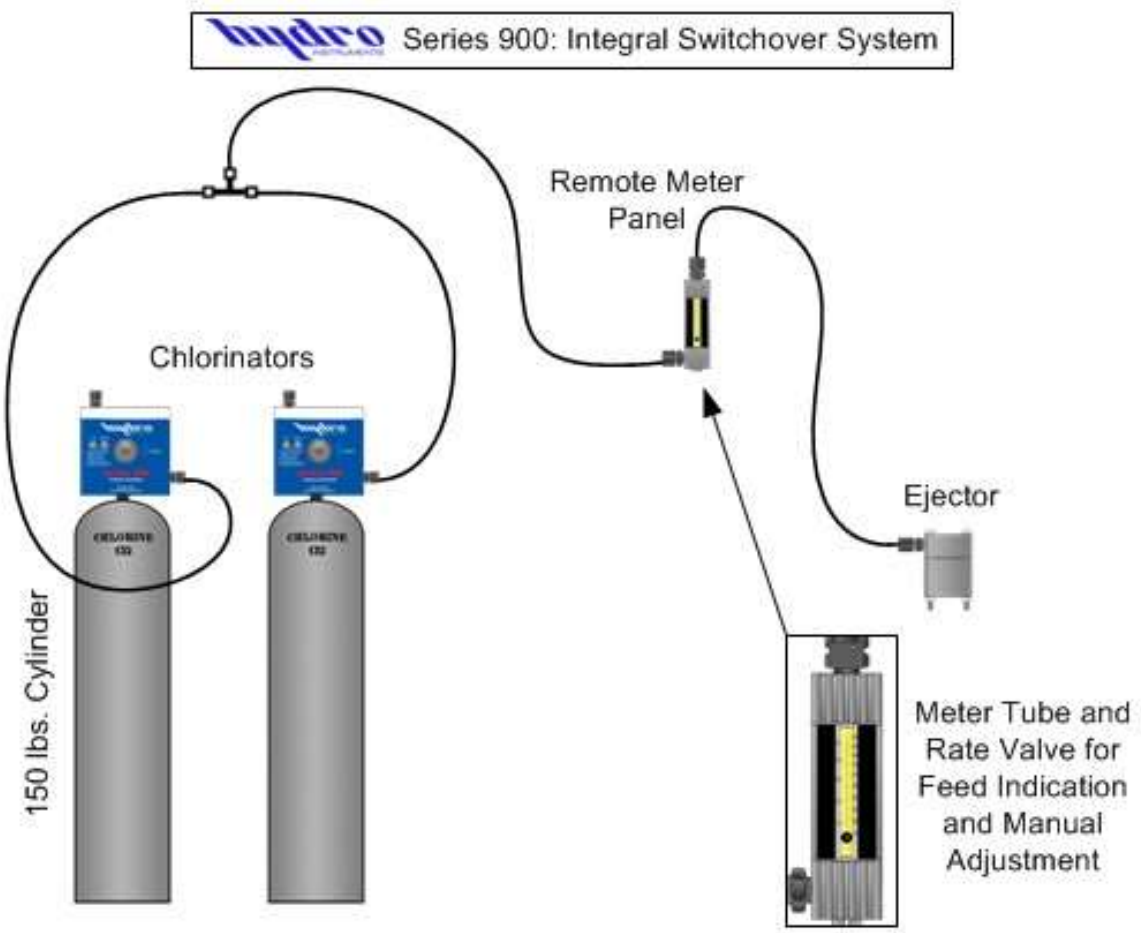
-Because a cylinder may expire when no operator is around to exchange it with a full one, systems are designed to switch on their own.

-When the on-line cylinder becomes empty, the system automatically begins to draw from a stand-by cylinder with its own Vacuum Regulator

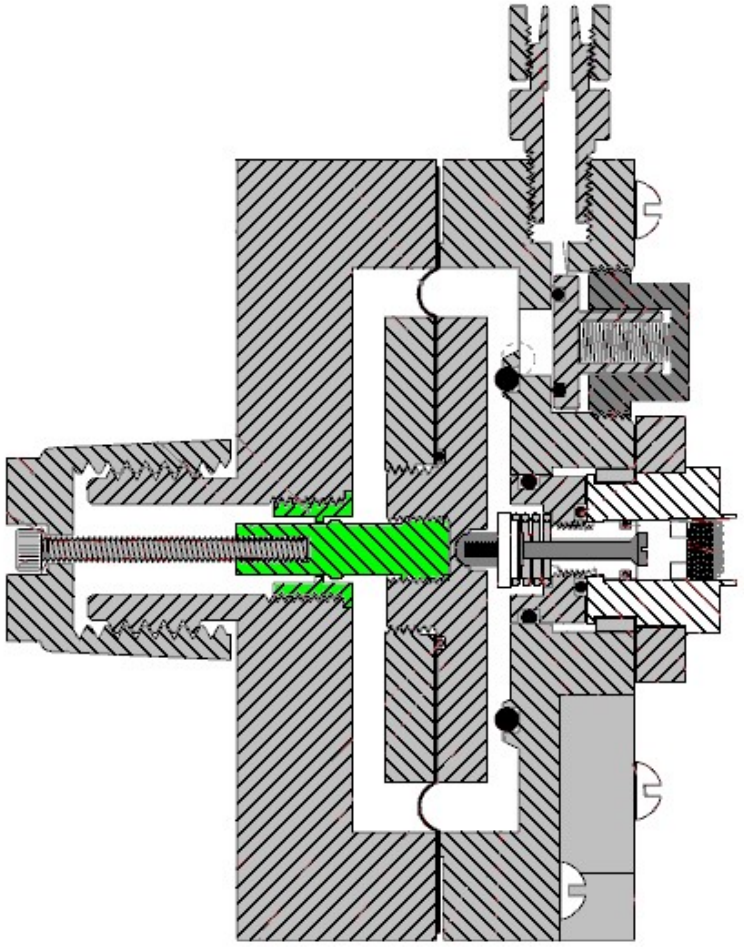




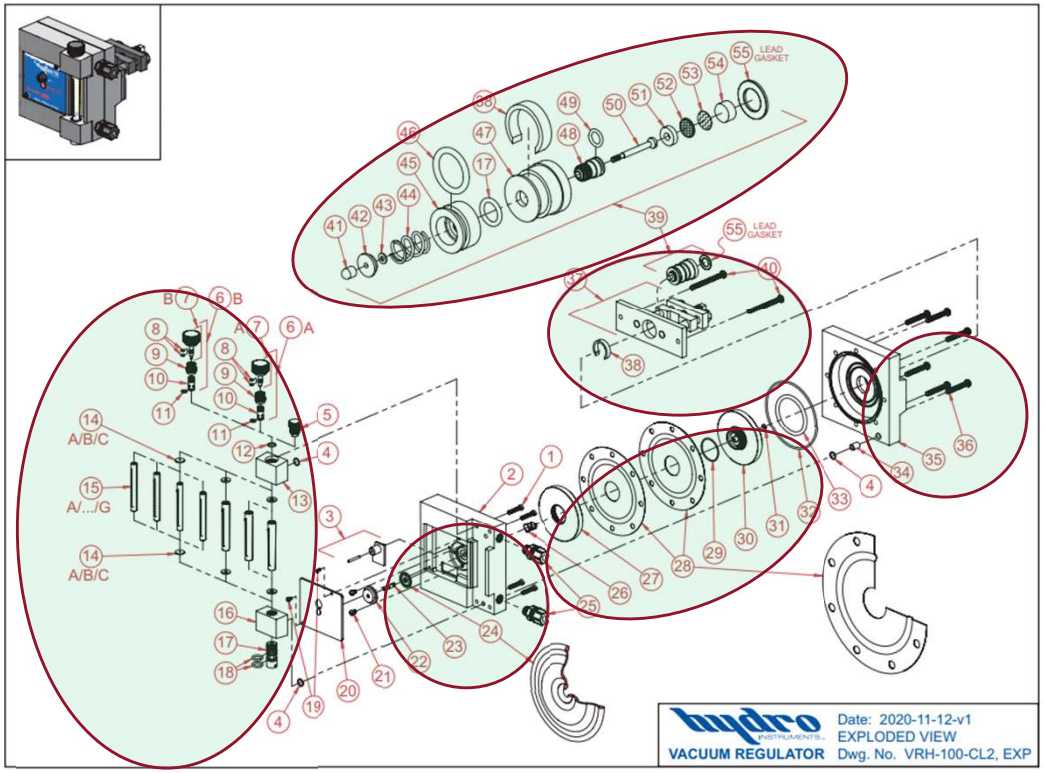
INTEGRAL SWITCHOVER SYSTEM



Integral Switchover

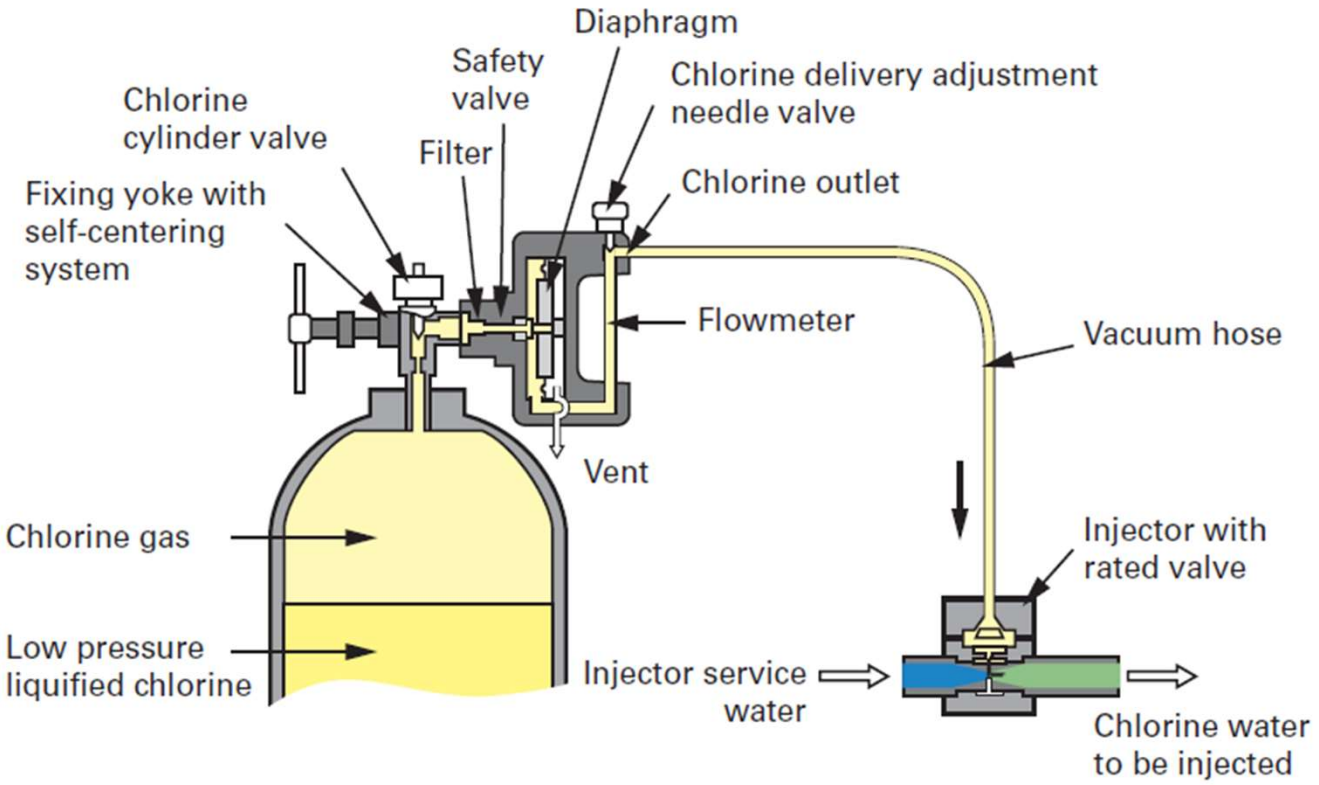


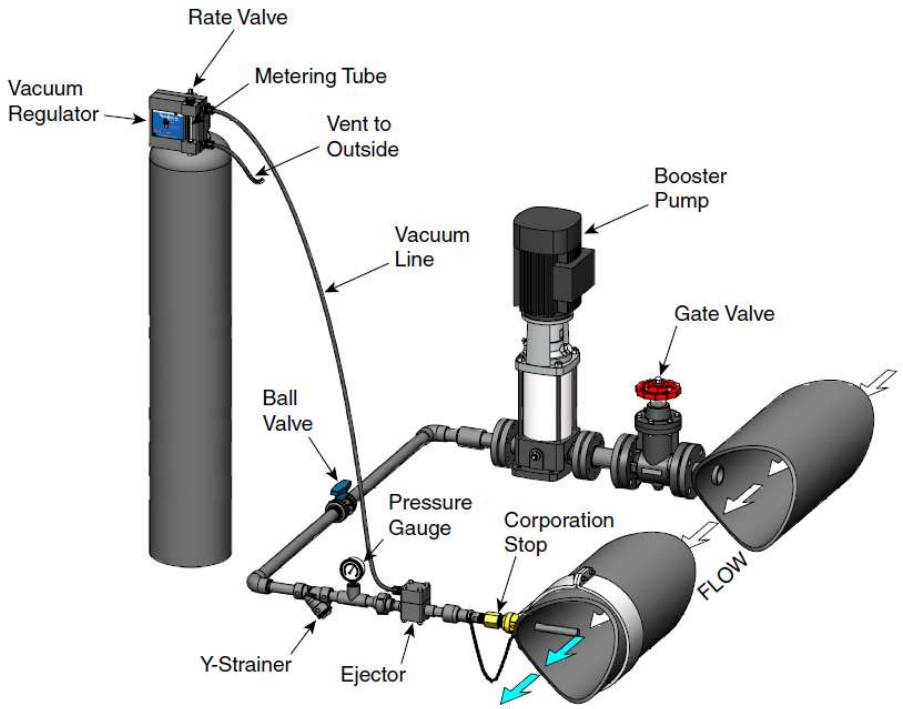
VACUUM REGULATOR



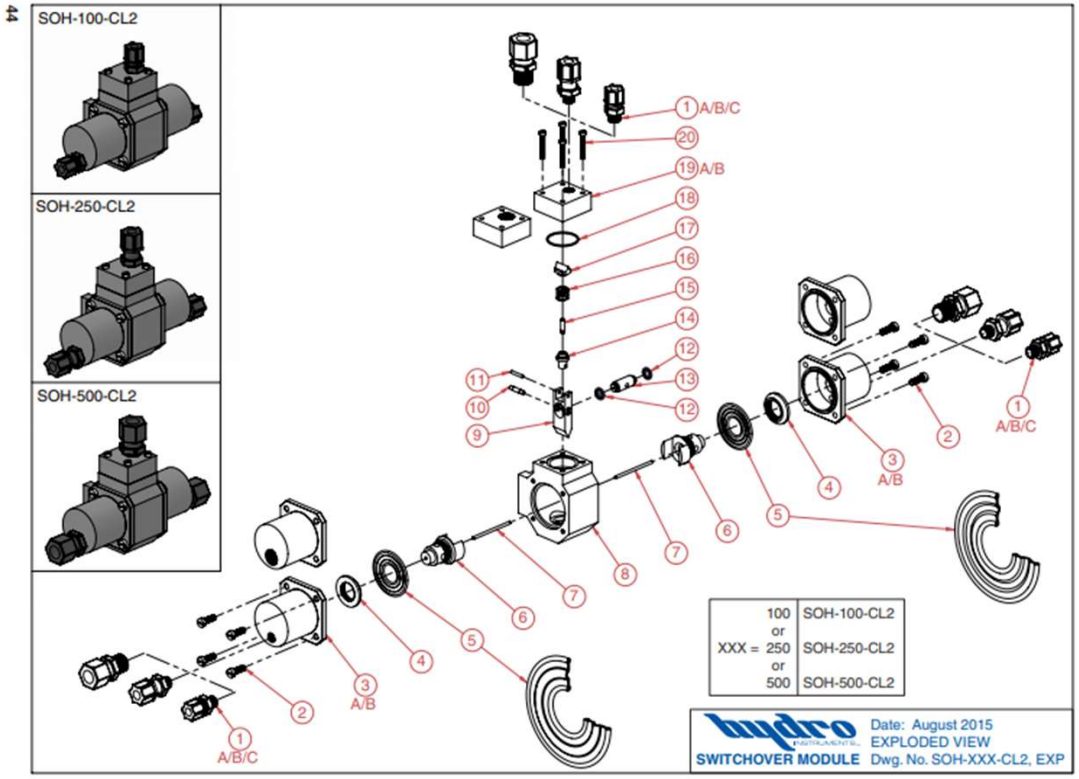
VACUUM REGULATOR

-Using the vacuum created by the process water flowing through the Ejector, the Vacuum Regulator safely allows gas to leave the cylinder and enter the system

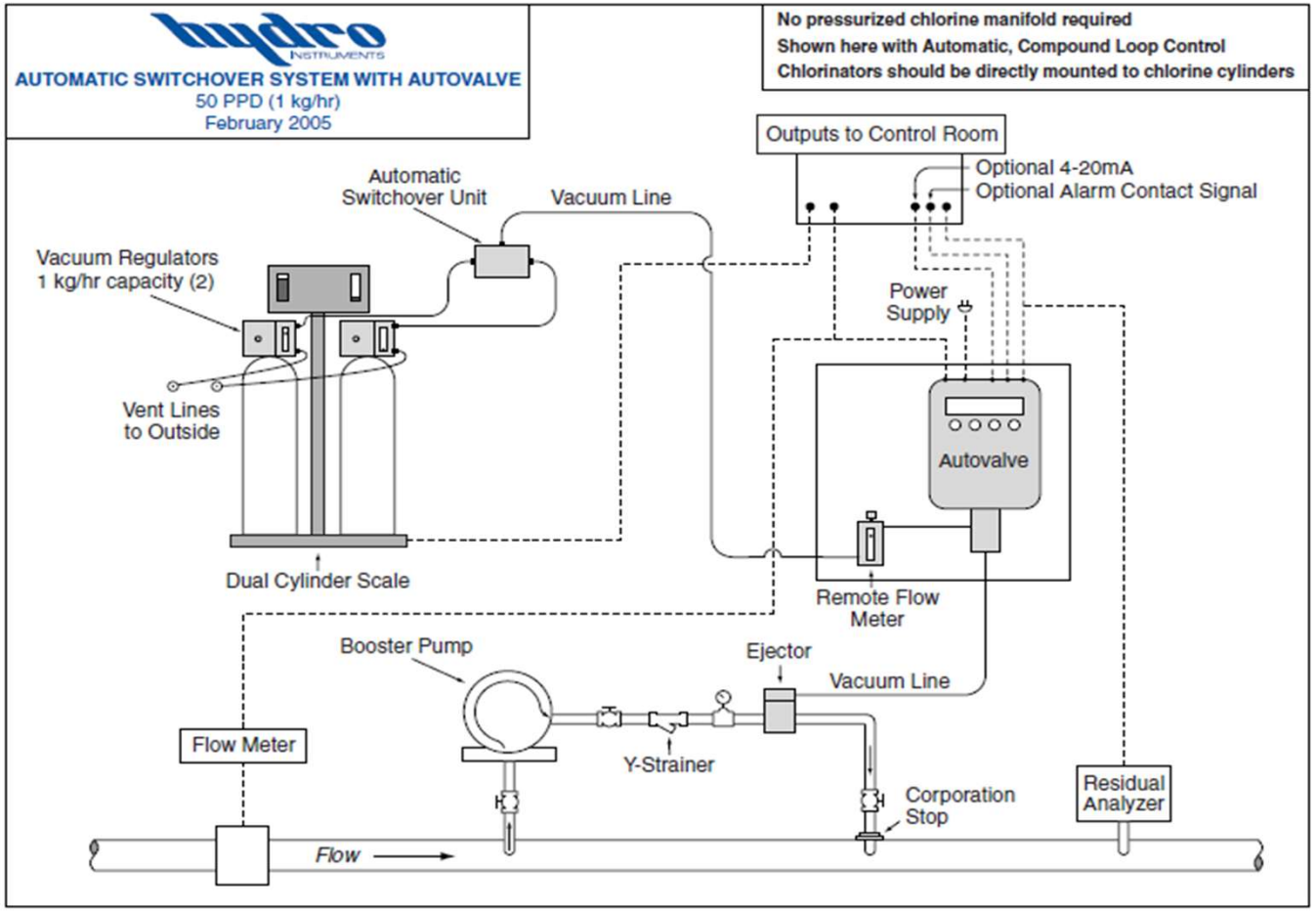

Diaphragm
Safety valve
Chlorine delivery adjustment needle valve
Chlorine cylinder valve
Filter
Chlorine outlet
Fixing yoke with self-centering system
Flowmeter
Vacuum hose
Vent
Chlorine gas
Injector with rated valve
Low pressure liquified chlorine
Injector service water
Chlorine water to be injected


Rate Valve
Metering Tube
Vacuum Regulator
Vent to Outside
Booster Pump
Vacuum Line
Gate Valve
Ball Valve
Pressure Gauge
Corporation Stop
FLOW
Y-Strainer
Ejector

SWITCHOVER MODULE



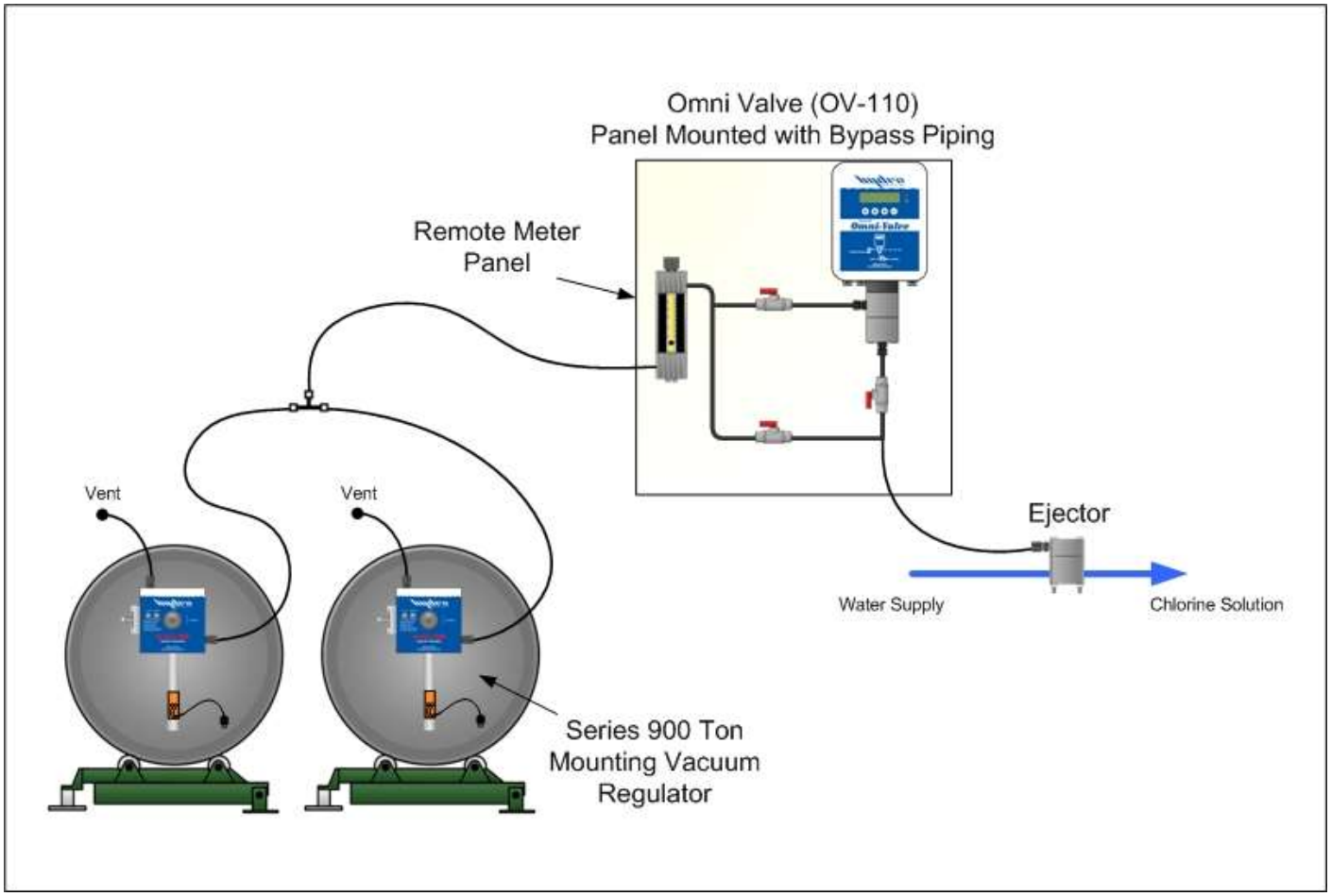
AUTO FEED CHLORINATION SYSTEM

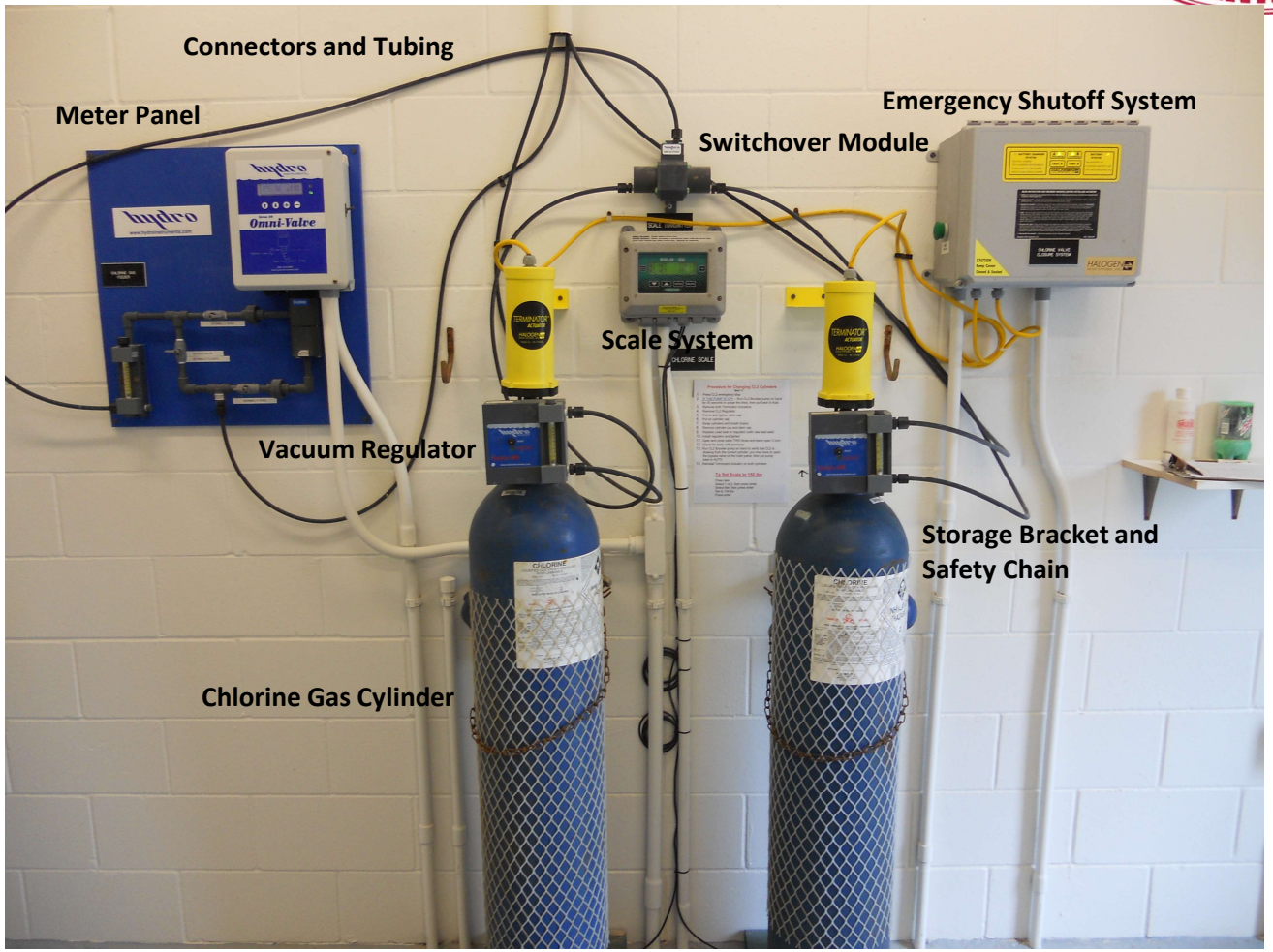


AUTOMATIC FEED RATE CONTROL

- Because water flow rates or Chlorine demand in a given system may fluctuate, an operator may want a device to change the Chlorine feed rate automatically.

-The Hydro OV-110 adjusts the gas feed as required based on signal input(s)


Omni Valve (OV-110)
Panel Mounted with Bypass Piping
Remote Meter
Panel
Vent
Vent
Ejector
Water Supply
Chlorine Solution
Series 900 Ton
Mounting Vacuum
Regulator


Connectors and Tubing
Meter Panel
Emergency Shutoff System
Switchover Module
Scale System
Vacuum Regulator
Storage Bracket and
Safety Chain
Chlorine Gas Cylinder
hydro
Omni-Valve
CHLORINE

PERISTALTIC OR DIAPHRAGM METERING PUMP?

WHAT IS A PERISTALTIC PUMP? HOW DOES IT OPERATE?

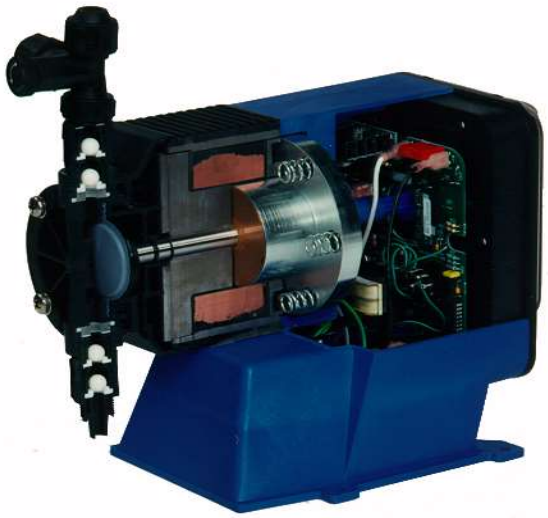
-A peristaltic pump is a type of positive displacement pump used for pumping a variety of chemicals

-A peristaltic pump is a self-priming pump that achieves pumping action by moving a system of rollers against a flexible tube.

-The pumped fluid is never exposed to the air or to the mechanical moving parts. The roller design prevents siphoning by providing a constant seal on the pumping tube.

HOW DOES A DIAPHRAGM PUMP OPERATE?

- Timer energizes and de-energizes the solenoid.
- When the solenoid is energized, it creates a magnetic force.
- The force causes the shaft to move forward against spring pressure.
- The diaphragm attached to the shaft pushes liquid out.



ADVANTAGES OF PERISTALTIC PUMPS VS. DIAPHRAGM PUMPS

Peristaltic Pumps	Action	Diaphragm Pumps
Automatic	Degassing	**Requires optional degassing valve**
Self-priming against pressure	Prime	**Must manually prime**
Primes up to 25 feet	Suction Lift	**Primes 3 to 5 feet**
No check valves in head	Check Valves	**Check valves prone to failure**
Interchangeable outputs with tube change	Versatility	**Must change drive and/or head**

ADDITIONAL PERISTALTIC PUMP ADVANTAGES

- No contamination. Because the only part of the pump in contact with the fluid being pumped is the interior of the tube, it is easy and clean the inside surfaces of the pump.
- Low maintenance needs. Their lack of check valves, seats, and seals makes them comparatively inexpensive to maintain.
- They can handle slurries, viscous, shear-sensitive and aggressive fluids with natural rubber hoses.
- Pump design prevents backflow and syphoning without valves.

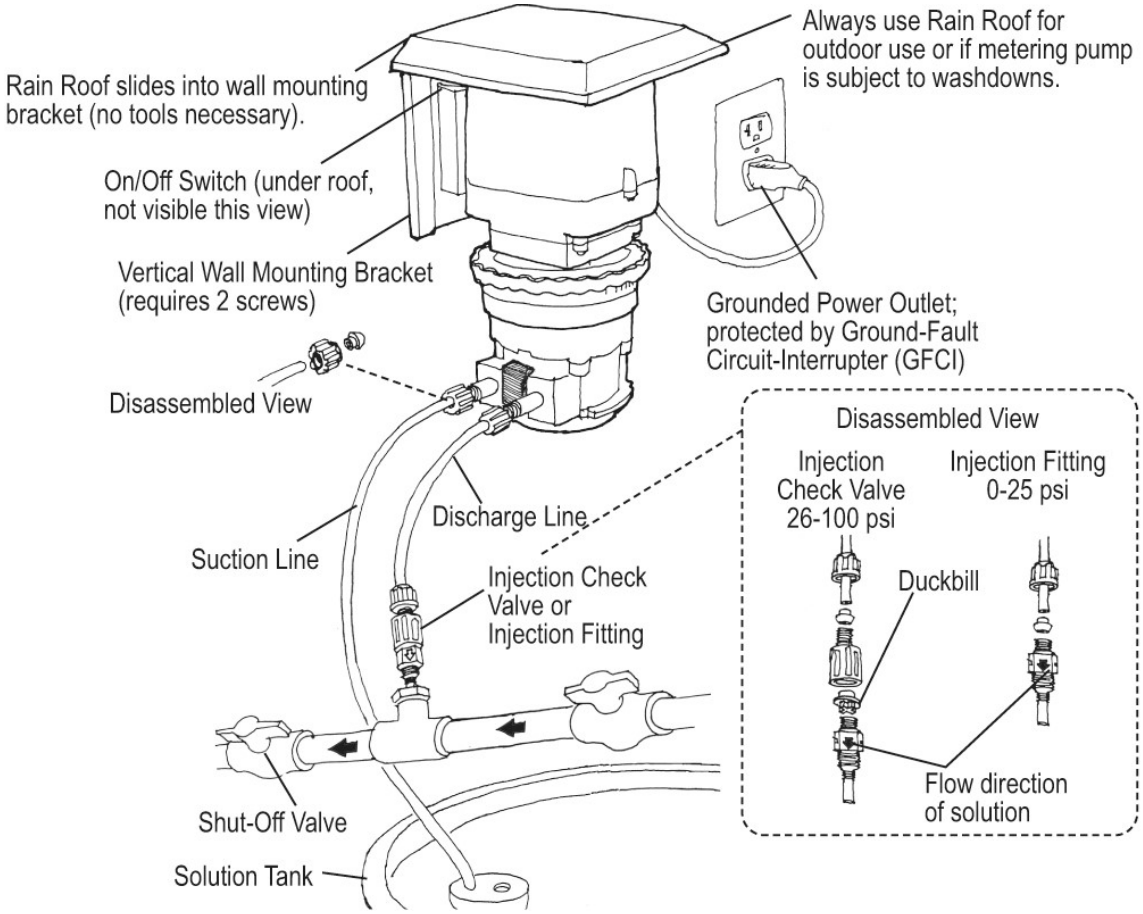
Why Peristaltic Pumps?

- Peristaltic
- Automatic degassing
- Self-priming
- Can prime up to 25 feet
- Slurries and viscous fluids
- No check valves in head
- Can mount in any position
- Interchangeable outputs with tube change
- Can operate dry

DISADVANTAGES OF PERISTALTIC PUMPS

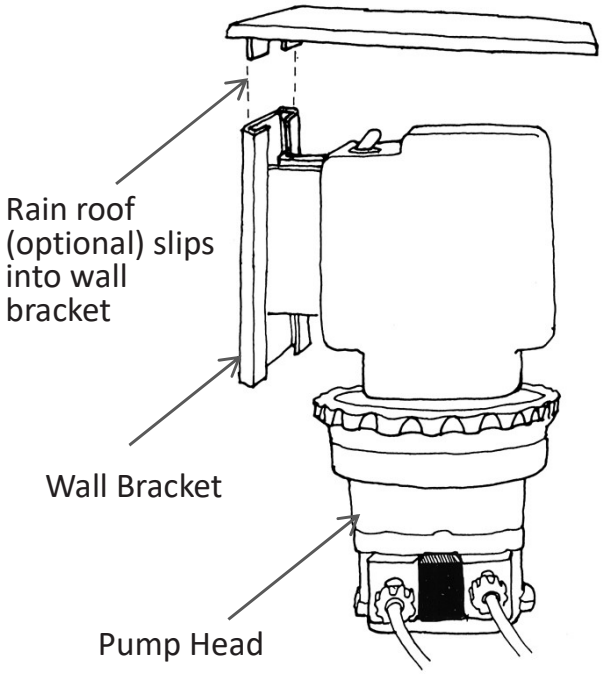
- The flexible tubing will tend to degrade with time and require periodic replacement.
- High pressure applications will drastically reduce tube life expectancy.

INSTALLATION FOR SINGLE HEAD STENNER PUMP



VERTICAL INSTALLATION

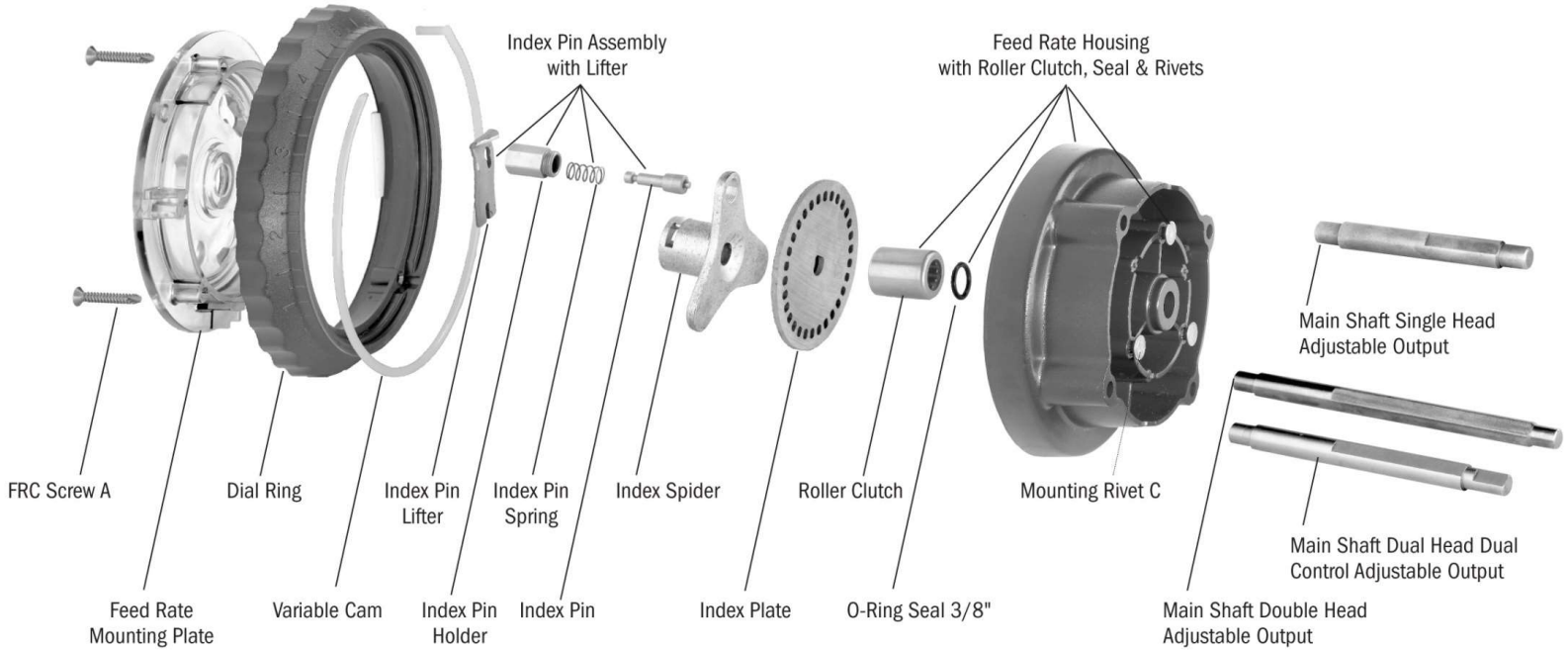
The pump motor is ventilated, and water intrusion can cause motor damage. A rain roof is recommended for outdoor and wet environments.



Vertical Mount with Rain Roof

CLASSIC ADJUSTABLE

STENNER FEED RATE CONTROL



Classic Feed Rate Control Parts

PUMP TUBE BASICS

The tube is the workhorse of the pump. It is perishable and will eventually stop functioning from natural wear or when it reaches the end of its service life. Indications of the end of service life are:

- Tube leaks
- Tube is fatigued causing a reduction or lack of output

PUMP TUBE PRESSURE RATING

PUMP TUBE	0-25 psi (0-1.7 bar)	26-100 psi (1.8-6.9 bar) Check valve required
#1	✔	✔
#2	✔	✔
#3	✔	
#4	✔	
#5	✔	
#7*		✔

* Classic Single Head ONLY

STENNER CLASSIC SERIES TUBE CHART

TUBE NUMBER REFERENCE CHART

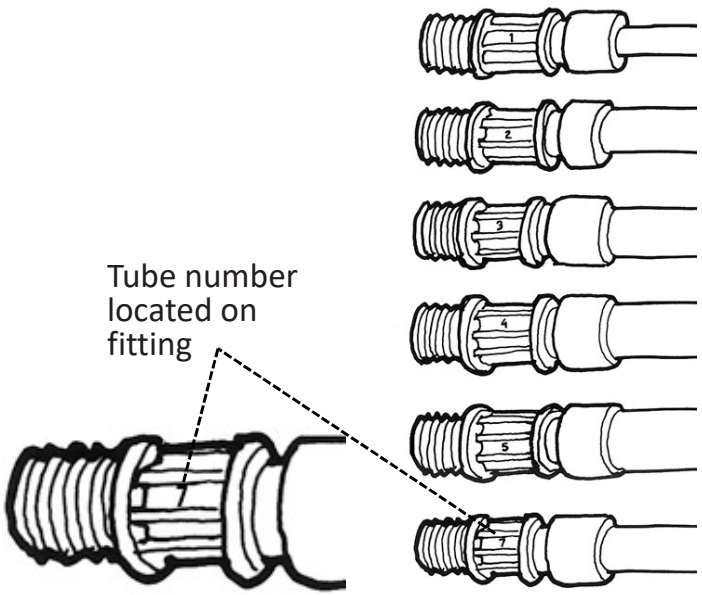
TUBE	CLASSIC 45 SERIES		CLASSIC 85 SERIES	
	Gallons per day		Gallons per day	
	Up to 25 psi	26-100 psi*	Up to 25 psi	26-100 psi*
#1	3	3	5	5
#2	10	10	17	17
#3	22	n/a	40	n/a
#4	35	n/a	60	n/a
#5	50	n/a	85	n/a
#7**	n/a	22	n/a	40

* Check valve required.
** Classic Series single head only.

STENNER PUMP TUBE BASICS

The pump tube service life can be reduced by the following conditions :

- Calcium or mineral deposits
- Sediment blockages
- Chemical incompatibility
- Corrosion
- Improper handling



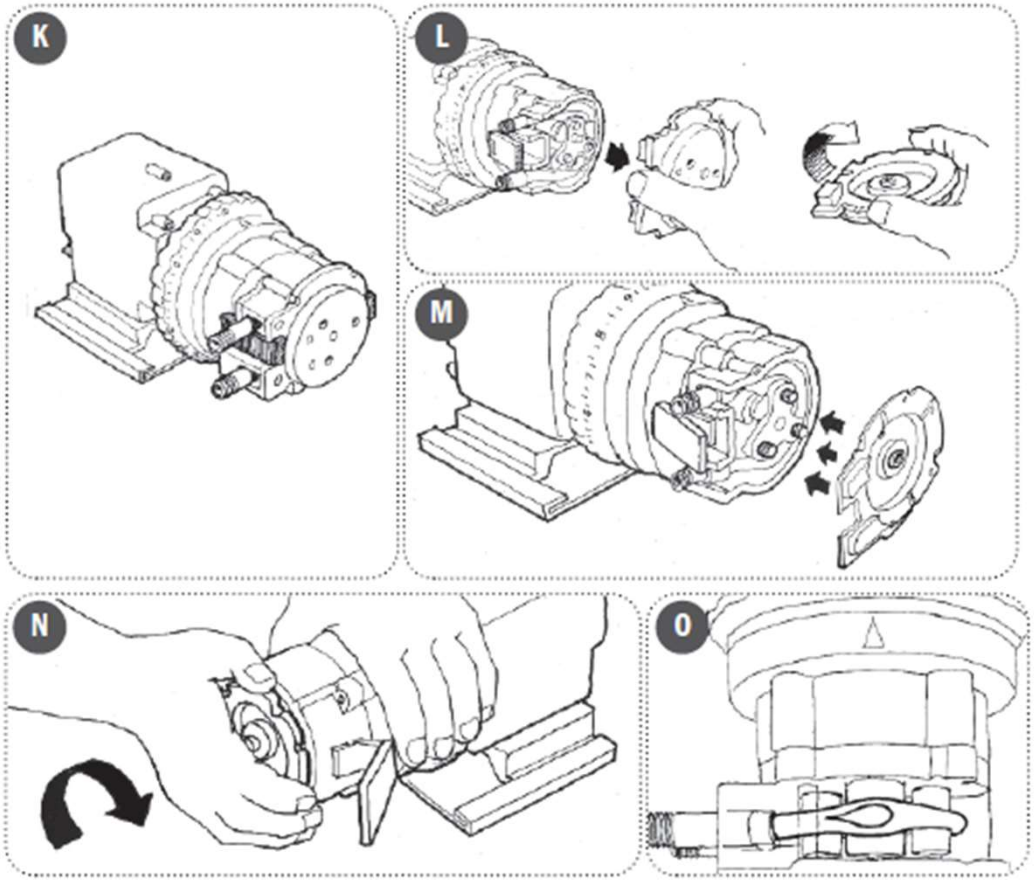
For maximum pump tube life, always identify the reasons for the failure and correct the problem before a new tube is installed.

TUBE LIFE TIMER

- **Most peristaltic pumps as a result, come equipped with a tube life timer.**
- **The manufacturer provides an estimated tube life based on material of the tube and chemical being pumped, but the most effective way to prevent leaks is to monitor your specific system and figure out where the typical failure point is. Once this is known you can monitor the tube life timer and replace the tube before it breaks.**

Quick Pro Pump Head

Quick Pro Tube Replacement



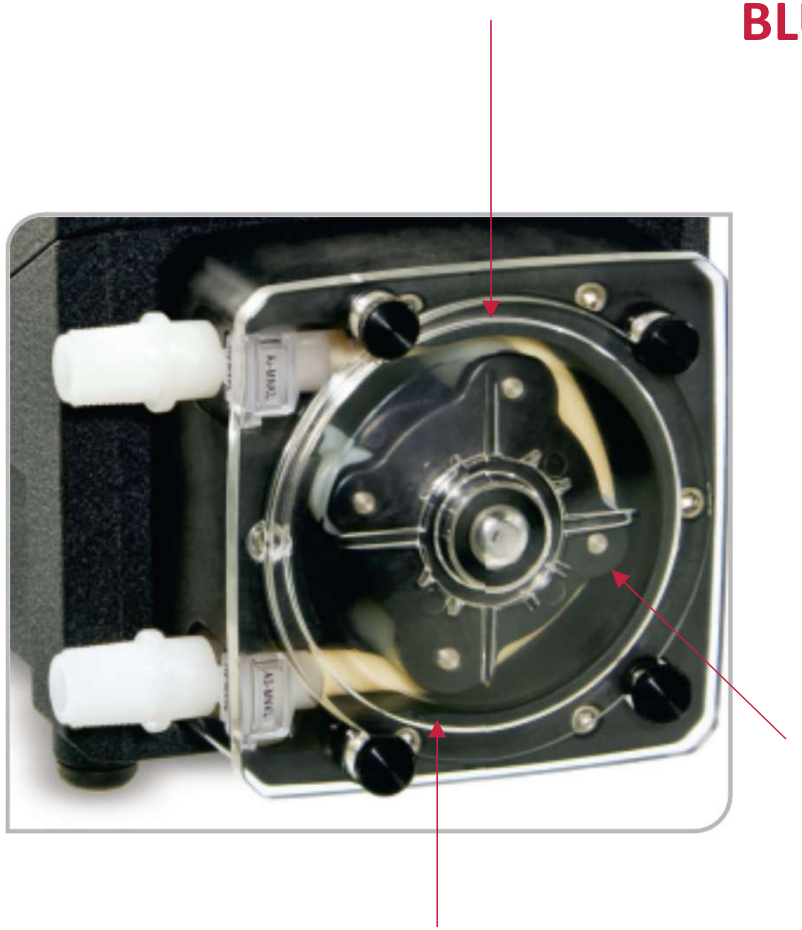
QUICK PRO PUMP HEAD SERVICE KIT 100 PSI

Injector used above 25 psi
up to 100 psi

BLUE-WHITE PERISTALTIC PUMP

- There are many different brands of peristaltic metering pumps, but all operate in much the same way, and as such have common maintenance points and issues.

BLUE-WHITE PERISTALTIC PUMP



- The most common and frequent routine maintenance point is the pump tube itself. This is the point of contact which propels the chemical being pumped to its injection point.

- The frequent cycling of the roller assembly eventually wears out the tube. If it is not preemptively replaced a chemical leak will occur inside the pump housing.

REPLACEMENT OF PUMP TUBES

- **Replacing a pump tube from one peristaltic brand to another is very similar.**
- **The following is an example of tube replacement on an A2 metering pump.**

Step 1

Wear protective clothing, face shield, safety glasses and gloves during tube replacement.

Relieve (remove) system pressure on discharge and suction side of pump. Failure to do so will cause solution to squirt when disconnecting tube connections. **SAFETY FIRST, REMOVE PRESSURE...**

Disconnect system plumbing from pump tube adapters.

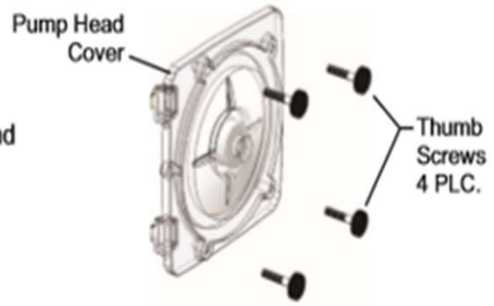
CAUTION

Step 2

Press and release STOP button.

Remove four black thumb screws from front of pump head cover. Turn screws counterclockwise to remove.

Remove pump head cover by pulling straight out.



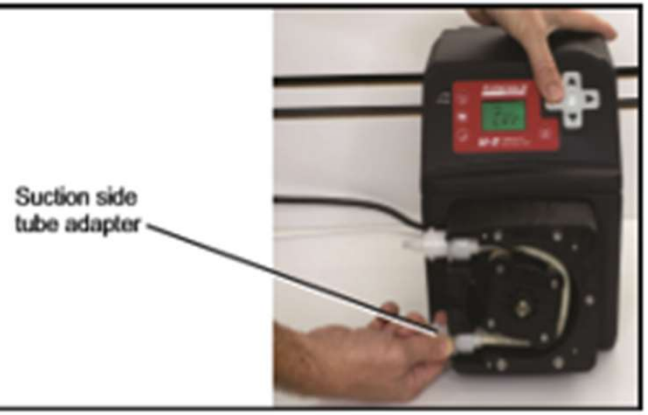
Step 3

With pump stopped, securely grab hold of suction side of tube adapter.

CAUTION! Keep fingers away from rollers and rotor.

Press and release START button to allow rotation of rotor.

Gently pull suction side tube adapter out, away from pump.



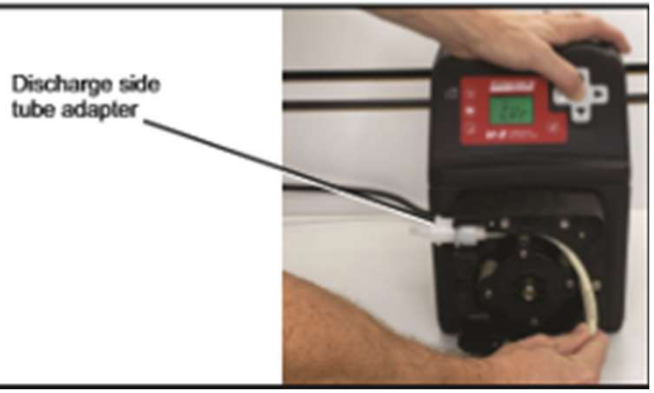
Step 4

Continue to pull suction side adapter out of pump head while rotor is in rotation.

Press and release STOP button.

Carefully pull discharge side of tube adapter out of pump head.

Dispose of used tubing properly.



INSTALLATION OF NEW TUBE ASSEMBLY

Step 1

Press and release stop button to ensure pump is stopped.

With pump stopped, press suction side of tube adapter securely into pump head.

Clip Tube Installation Tool to discharge side of tube adapter.

Always keep fingers away from rollers and rotor.

Step 2

Your hand should only come in contact with installation tool.

Press and release START button.

Use installation tool to leverage tubing into pump head while rotor is rotating.

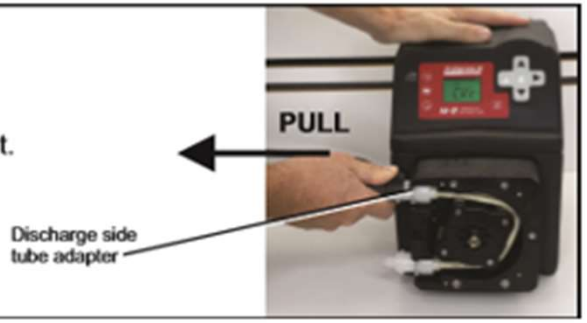
Step 3

Continue to hold onto installation tool.

Allow rotor to rotate a few times, this will stretch tubing out.

After a few rotations, pull installation tool and tubing in direction of rotation.

Press discharge side of tube adapter securely into pump head.

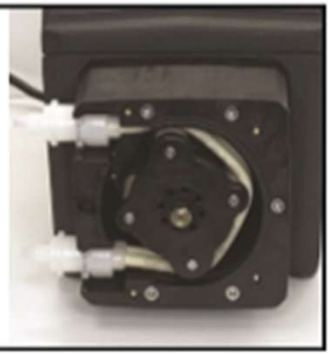


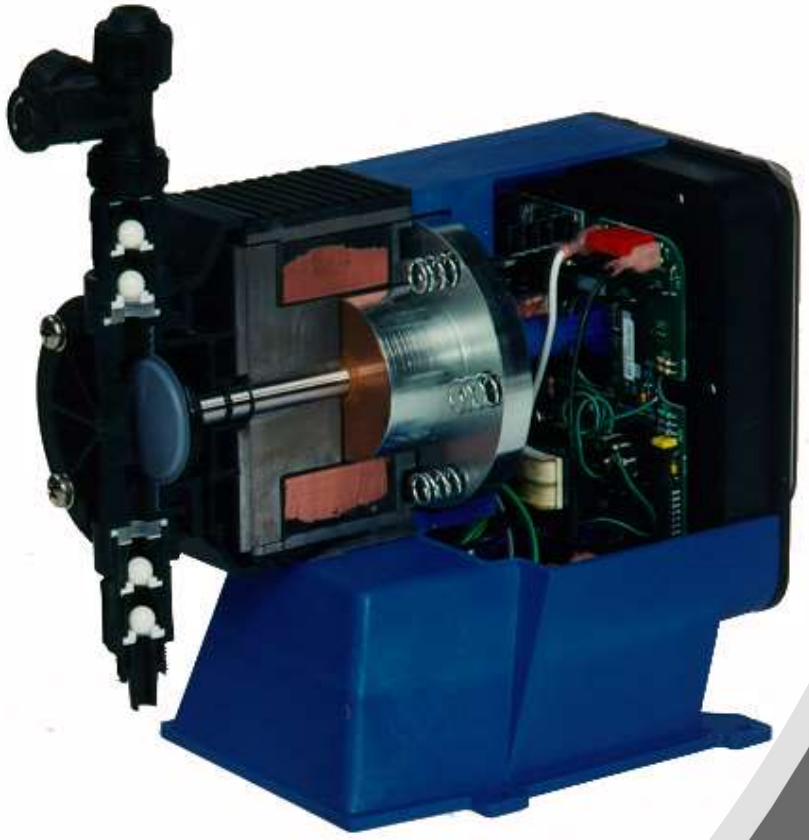
Step 4

Press and release STOP button on pump.

Suction and discharge tube adapter ends should be securely held in place on pump head as illustrated in photo.

Secure pump head cover to pump head using four black thumb screws.





Solenoid Driven Diaphragm Metering Pump

THEORY OF OPERATION

- Timer energizes and de-energizes the solenoid.
- When the solenoid is energized, it creates a magnetic force.
- The force causes the shaft to move forward against spring pressure.
- The diaphragm attached to the shaft pushes liquid out.

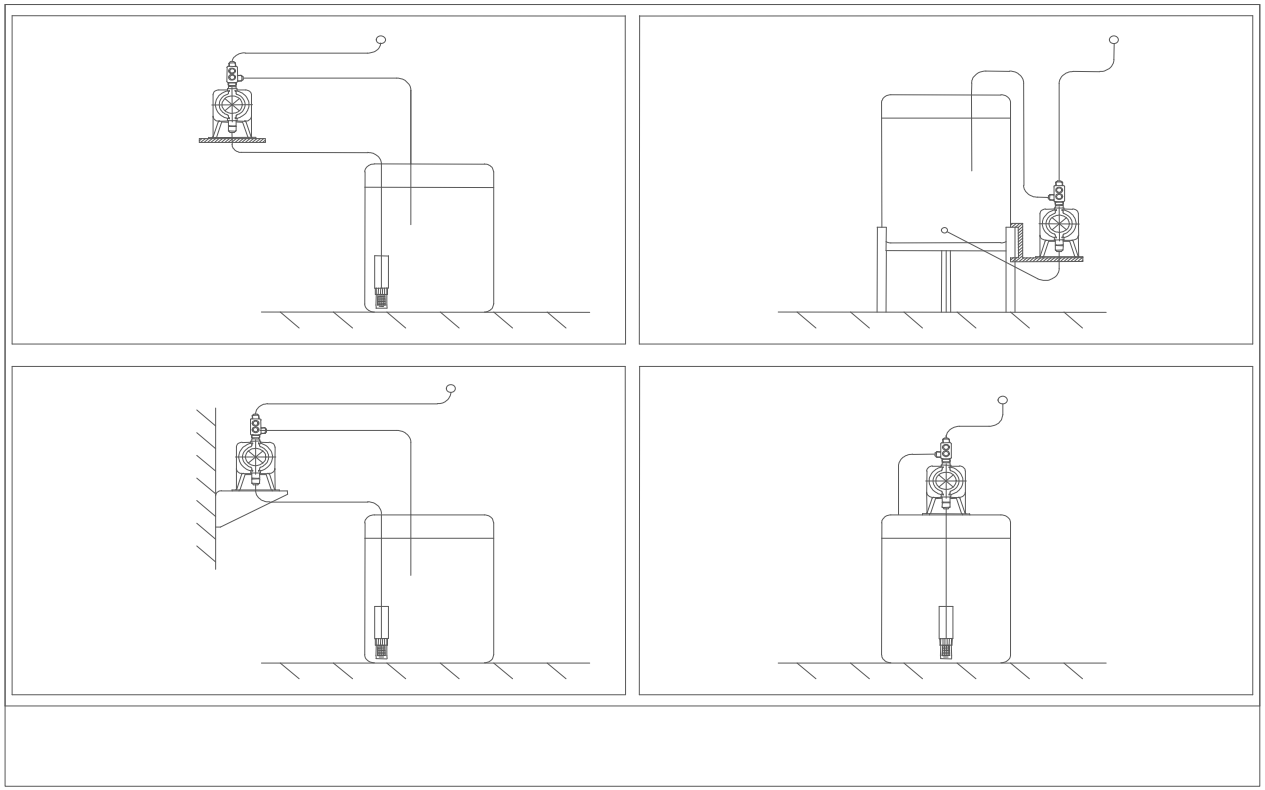
THEORY OF OPERATION

- **When the timer de-energizes, the solenoid, shaft and diaphragm return.**
- **This is accomplished by the spring pressure.**
- **The cycle then continues.**

THEORY OF OPERATION

- **The fluid is pushed out of the head when the solenoid is energized.**
- **The fluid is then pulled in when the solenoid is de-energized.**
- **The check valves in the foot, suction, discharge and injection valves, keeps the fluid flowing in one direction.**

DIAPHRAGM PUMP INSTALATION OPTIONS

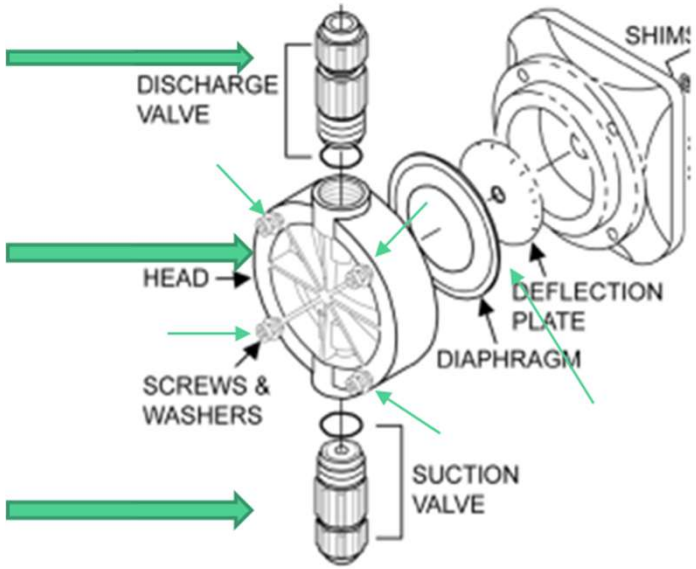


START UP AND OPERATION

- **Priming**
  - Turn on the power to the pump. Operate at 100% full rate and stroke.
  - Open the bleed valve adjustment screw counter-clockwise. Run with valve open until a steady stream of chemical, with no bubbles, comes out of the return tubing
  - Close the bleed valve adjustment screw clockwise. Chemical should reach the pump head after a few minutes of operation.

MAINTENANCE

- **Routinely check the physical condition of the pump. Look for:**
- Abnormal noise
- Excessive vibration
- Low flow
- Pressure Output
- Temperatures



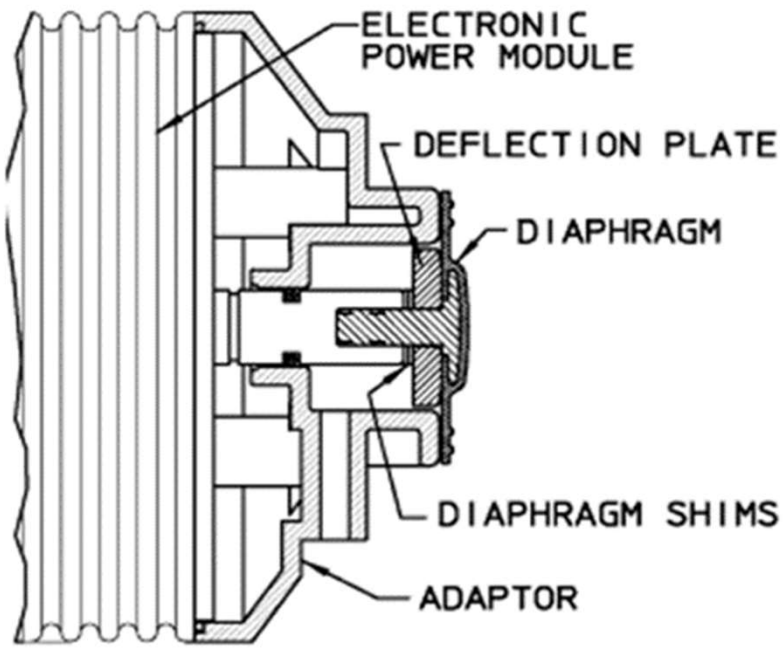
MAINTENANCE

- **For optimum performance, Cartridge valves should be cleaned after every 4-6 months, Depending on the application.**
- **Check for leaks around fittings.**
- **Keep pump free of dirt or debris.**

DIAPHRAGM REMOVAL

Pump	Set	Disconnect	Remove
Flush pump head and valve assembly	Set stroke length to 50% and unplug	Disconnect tubing or piping from pump	Remove the four head screws and pump head

DIAPHRAGM REMOVAL



1

Remove

- Remove the diaphragm by grasping it at the outer edges and turning it counter-clockwise.
- Do not lose the deflection plate or shims from behind the diaphragm.

2

Inspect

- Inspect diaphragm if it is intended to be used again.
- Check for the teflon face being cracked or overstretched.
- check to see if the elastomer on the back of the diaphragm is being worn.

DIAPHRAGM REPLACEMENT

01

Slide the deflection plate onto the back of the diaphragm stud, radius side towards the diaphragm.

- ***Note: Deflection plate is not part of a KOPKIT***

02

Slide 2 shims onto the diaphragm threaded stud and screw the diaphragm onto the solenoid. Turning clockwise until the deflection plate and shims are tight against the solenoid shaft.

DIAPHRAGM REPLACEMENT

- **If there is a gap between the adapter and the diaphragm, repeat the procedure removing one shim each time until the diaphragm just touches the adapter.**
- **Apply grease to the areas of the diaphragm that contacts the deflection plate.**

DIAPHRAGM REPLACEMENT

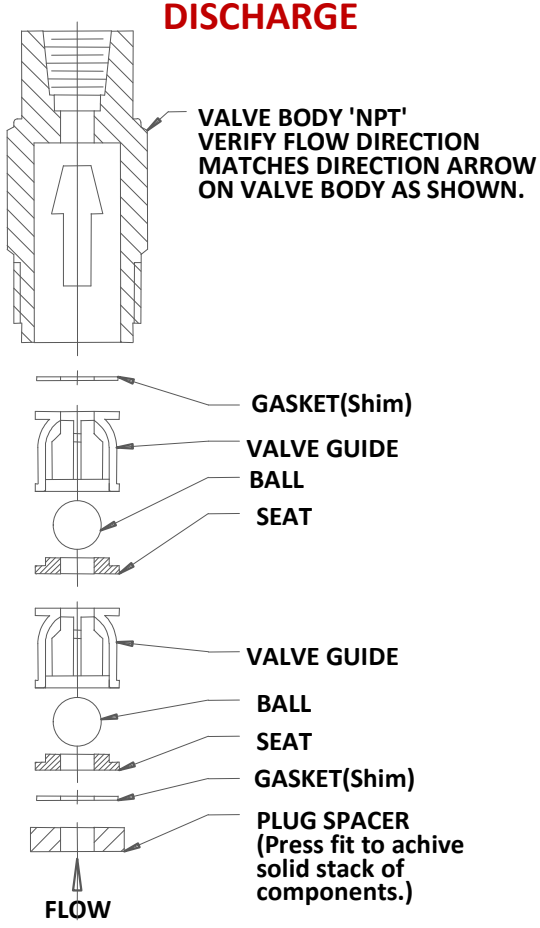
- Adjust stroke length to 50%.
- Place pump head onto the adapter and install and tighten pump head screws.
- Adjust stroke length back to 100% for easier priming.

VALVE REPLACEMENT

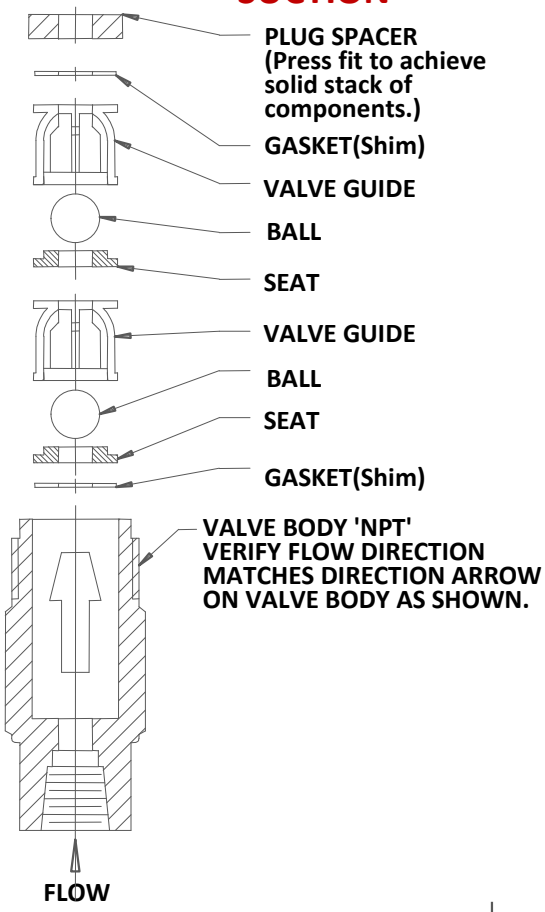
- **Unplug pump, release system pressure, and disconnect any tubing or piping.**
- **Unscrew valve cartridges and discard. Also discard o-rings from inside pump head.**
- **Using new O-rings, install new cartridge valves with arrows pointing towards flow.**
- Hand tighten only

VALVING ASSEMBLY DOUBLE NPT-FITTING

DISCHARGE



SUCTION



MISCELLANEOUS MAINTENANCE POINTS

- **There are a few other maintenance areas not inherent to the pump itself that can cause chemical leaks and/or damage to your pump.**
- **These areas include the suction strainer, suction and discharge tubing, and the injection check assembly.**

Weighted Suction Line Strainer

SUCTION STRAINER

- The suction strainer is the first step in the injection process. Its job is to strain out any impurities or particulates from the chemical being pumped. Over time they can become clogged Reducing the effective capacity of the pump. They are also typically equipped with a ball check to prevent the suction line from draining back into the tank. Making sure this device is clear and in an upright position is crucial to efficient chemical metering pump functionality.

CHEMICAL TUBING

- An oft forgotten component of pump maintenance is the tubing itself. Over time the tubing, being in a chemically harsh environment and subject to temperature changes, can become brittle and prone to breakage. They can also become gummed up depending on the chemical being pumped, reducing effective capacity. It is recommended that these lines are replaced every one to two years.

INJECTION ASSEMBLIES

- Much like the strainer assembly at the beginning of our pumping process, the injection point at the end of the line can become plugged with debris and chemical build up over time. It is recommended that these devices are periodically removed, inspected, and cleaned, if necessary, to remove anything plugging the line. Failure to do so can prevent chemical feed and/or create pump damaging back pressure as its dead heads into the obstruction.

Thank you