EJECTORS

GENERAL OPERATION & MAINTENANCE MANUAL

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Ejectors

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TABLE 1 – Torque Specifications

Item	Minimum (in/lbs.)	Maximum (in/lbs.)
Check Valve Body Bolts	20	25
1-1/4” Ejector Flange Bolts	20	25
Van Stone Flange Bolts	300	300
Vacuum Fitting	15	20

I. DESING AND INSTALLATION NOTES

A. General Information

1. See Hydro Instruments Booster Pump and Ejector Guide for general guidance.
2. Choosing Ejector Feed Capacity – Ejectors must be selected to be capable of injecting chemical at the maximum required feed rate for the injection point.
3. Always consider the nozzle charts for hydraulic requirements of each ejector. Most ejectors have more than one 'nozzle' or 'nozzle/throat combination' available for you to choose from. *NOTE: There is no standard nozzle/throat combination for each ejector. The nozzle/throat combination must be selected in each case.*
4. Total Back Pressure – Total back pressure is the pressure in the pipeline to be chlorinated plus the friction losses in the solution line between the ejector and the point of injection. Hydro Instruments manufactures ejectors capable of operating up to back pressures between 100 and 300 PSIG (7 to 20 bar) depending on the ejector model and capacity. See individual ejector specifications for details.
5. It is preferable that the ejector be located near the point of solution injection in order to eliminate the need for pressurized chemical solution lines. Friction losses in the solution line will increase the ejector back pressure. Friction losses can be reduced by increasing the solution line internal diameter and limiting the number of flow restrictions (e.g. equipment and instrumentation) and turns. Also, be sure that the solution line material is resistant to the highly concentrated chlorine mixture.
6. In situations where there might be a siphon condition during times when the ejector is not operating, an anti-siphon ejector can be considered to prevent unwanted injection of chemicals into empty pipes. This could be relevant to systems where the ejector is mounted at a higher topographical elevation than its injection point and/or injects into a below ground tank, cistern or swimming pool.
7. Hydro Instruments makes variable orifice ejectors for 2", 3" and 4" flange style ejectors. This option can be used to save water and optimize performance at each site. See individual product literature.
8. When installing a pressure gauge downstream of the ejector, ensure that the gauge has suitable diaphragm protection to prevent corrosion damage to the gauge.
9. Consider using an injection quill or corporation stop where the chemical solution line enters a process pipe or tank to avoid corrosion damage to the pipe/tank wall. Open channel diffusers can be used when injecting into a contact chamber.
10. Drain valves are available for some ejectors. The drain valve is designed to remain sealed closed during operation of the ejector, but in the event of failure of the ejector check valve, water would flow back to the drain valve in the vacuum piping and it will open to allow the water to drain out of the system. This is useful to avoid the water entering and damaging chemical feed equipment in the vacuum piping.

11. Secondary check valves are available to provide better protection against back flooding of water caused by check valve failures.
    NOTE: Secondary check valves can cause a reduction in feed rate capacity. They must be chosen carefully to avoid this problem.

II. SYSTEM INSTALLATION

A. Mounting Orientation

1. The larger ejectors using ball check valves and drain valves (e.g. EJH-3200-CL2, EJH-3120-CL2, and EJH-4120-CL2) must be installed with the water flowing vertically upward due to the orientation requirements of the ball check valve and the drain valve.
2. In general, all other ejectors made by Hydro Instruments can be installed in any orientation.

B. Installation of the Ejector

1. Various ejectors have a range of water inlet and outlet connections including ¾" NPT, 1-1/4" NPT, as well as 2", 3" flanged four bolt or 4" flanged eight bolt, 150 lb., Van Stone style in Schedule80 PVC.
2. Typically the shorter end of an ejector is the water inlet (nozzle side) and the longer end is the chlorinated solution outlet, but you should refer to the parts drawings relevant to each ejector prior to installation.
3. If using flanged ejectors, then install both flanges carefully with new flange gaskets from Hydro Instruments.
4. Pressure gauges of an appropriate scale should be installed upstream and downstream of the ejector. The downstream gauge should be diaphragm protected. These gauges are used to verify proper conditions are being met for proper ejector operation.
5. Unions and valves , upstream and downstream of the ejector are recommended. The valves are used to isolate the ejector and the unions facilitate easy removal for maintenance.

NOTE: Before installing any ejector it is important to remove debris (e.g. PVC shavings, etc.) from the piping; vacuum line and water line. Failure to remove debris can cause ejector check valve failure and/or cause a blockage in the ejector nozzle.

C. Testing

NOTE: The vacuum regulator should not be connected and the chlorine container valves should remain closed.

1. Refer to **Figure 1** for proper piping hook up to the ejector.
2. On the water inlet side to the ejector nozzle the following should be installed:
    - ✓Water inlet ball valve
    - ✓Y-strainer
    - ✓Pressure gauge
3. If using a booster pump to operate the ejector…

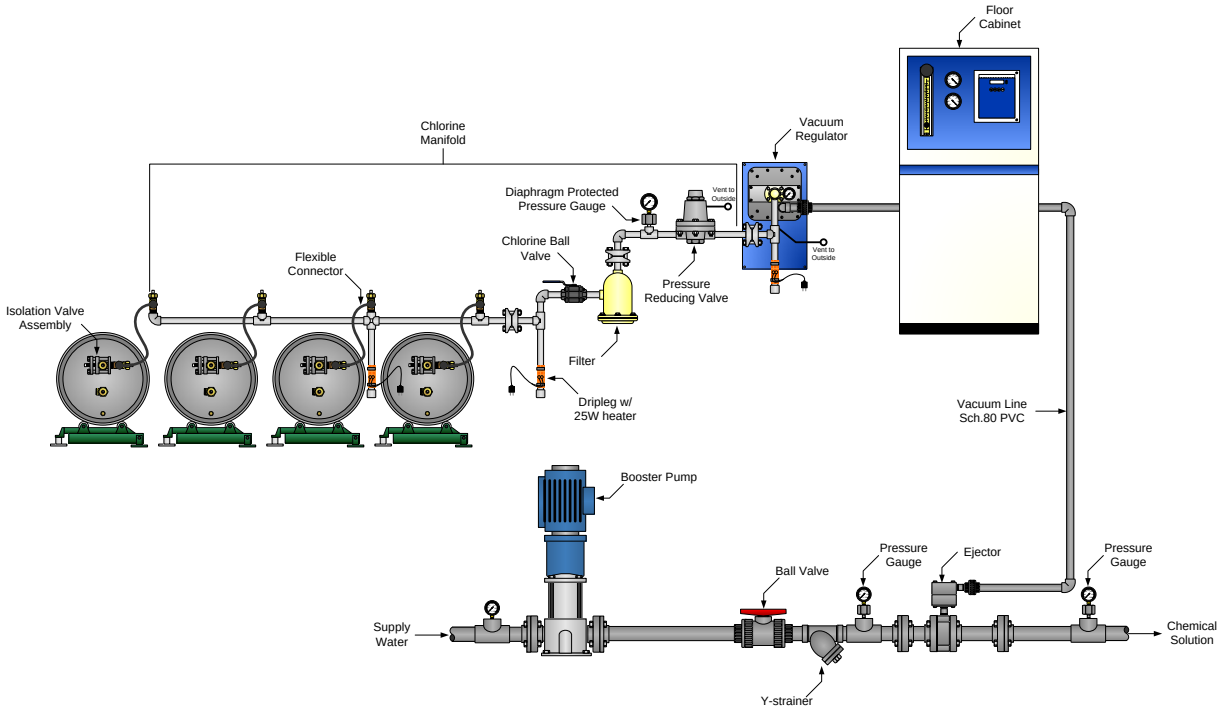
i. The ejector should be installed downstream at a sufficient distance so that chlorinated water is not recirculated through the booster pump. Also check that the booster pump is operating in the proper direction and is properly wired for power.

ii. Open the water inlet valve to the ejector followed by starting the booster pump. The pressure gauge at the inlet of the ejector should indicate a sufficient boost. See the ejector nozzle curves relevant to the ejector nozzle being used to verify. If the booster pump is operating properly there should be a strong vacuum at the ejector. You can feel for suction with your hand at the vacuum connection of the ejector.

4. If operating with system water pressure (i.e. no booster pump)…

   i. Open the water inlet valve to the ejector. If there is sufficient supply pressure there should be a strong vacuum at the ejector. See the ejector nozzle curves relevant to the ejector nozzle being used to verify. You can feel for suction with your hand at the ejectors vacuum connection of the ejector.

FIGURE 1 – Ejector Installation



III. TROUBLESHOOTING

A. No Chemical Feed or Reduced Chemical Feed

1. No vacuum or a weak vacuum being produced by the ejector – Disconnect the vacuum line at the ejectors vacuum connection and with your hand, feel for a vacuum at the ejector. If no vacuum exists or a weak vacuum is present, check in this order:
   i. Nozzle – Turn off the water supply and remove the ejector from the water line to inspect the nozzle as it may be clogged with a stone, debris or other foreign matter. Clear any blockages and reinstall. If there is a buildup of rust, iron or manganese in the nozzle place the nozzle into an aqueous acid solution for several minutes until the buildup has dissolved. *NOTE: It may be necessary to clean the nozzle on a preventative maintenance schedule.*
   ii. Water Supply – Check that the water supply is still adequate (i.e. supply pressure and GPM water flow). See the ejector nozzle curves relevant to the ejector nozzle being used to verify. The water supply pressure and/or flow may have diminished due to a clogged Y-strainer or possibly issues with the booster pump.
   iii. Solution Lines – Clogged or partially blocked solution lines will increase ejector back pressure. This increase in back pressure can create a condition in which the supply pressure and/or water flow becomes inadequate to properly operate the ejector nozzle. The clogged or partially blocked solution line should be cleaned or replaced. Also check that any injection quills or open channel diffusers are not clogged or partially blocked.
   NOTE: Check valves and/or back flow preventers installed into the solution line can cause an increase in ejector back pressure.
   iv. Ice – In cold weather conditions ice may form in the ejector nozzle and/or underneath the ejector check valve. Check for the accumulation of ice in these areas and clear any blockages.
2. Blockage or restriction in the vacuum line – Check all ball valves, solenoid valves, feed rate control valves, etc. to ensure that they are fully open and not blocking or restricting gas flow.
3. Depleted gas source – Check that the gas cylinders or ton containers are not empty and that their valves are open.

B. Water In The System

1. Ejector check valve failure – Ejector check valves can fail for many reasons including, but not limited to:
   - Objects or materials in or around the check valve preventing the closure of the ejector check valve.
   - Accumulation of debris on the check valve O-ring seal and/or its mating surface.
   - Accumulation of debris on the ejector check valve ball and/or its mating surface.
   - A tear or puncture in the ejector check valve diaphragm.
   - Extreme deformities (i.e. stretching) in the ejector check valve diaphragm can inhibit parts from moving and sealing correctly.

- Scratches and/or deformities on the surface of the ejector check valve ball.

For corrective action see Appendix section A-ii.

2. Ejector drain valve failure – Ejector drain valve can fail for many reasons including, but not limited to:
    - Objects or materials in or around the drain valve preventing the closure of the drain valve.
    - Accumulation of debris on the drain valve O-ring seal.
    - A tear or puncture in the drain valve diaphragm.

    For corrective action see Appendix section A-iii.

APPENDIX A: REPAIR AND PREVENTATIVE MAINTENANCE

The following are recommended maintenance instructions.

Guidelines for preventative maintenance:

1. Service ejector as needed, at a minimum of every 12 months. (See Appendix A-I and A-II)
2. Replace vacuum tubing every 12-18 months.
3. Inspect and clean PVC vacuum piping every 12-18 months. Replace as needed.

CAUTION: Use all recommended precautions when using chemicals of any kind, including protective eyewear, gloves, face shields, etc. After any of the listed repair procedures, it is necessary to go through a prescribed System Start-Up and Vacuum Test again.

SECTION A-I: EJECTOR NOZZLE & THROAT

NOTE: Carefully follow shutdown procedures before performing this repair.

For all ¾" Ejectors:

1. Shut off the gas source and evacuate the system completely.
   NOTE: In some cases is may be necessary to, with the ejector operating and creating a vacuum, remove the vacuum tubing at the vacuum regulator and allow the system to draw air through the system for several minutes to evacuate all of the gas in the vacuum line.
2. Isolate the ejector on both the water inlet and outlet sides to prevent leakage of water or gases.
3. Disconnect the vacuum line.
4. Disassemble the inlet and outlet water connection unions and remove the ejector from the pipeline.
5. Unthread the nozzle and tail piece from the ejector body. Take care not to damage the threaded portions.
   NOTE: When reinstalling the nozzle and its mating part, be careful not to overtighten. Overtightening of these parts may result in brakeage or weak points in these parts which could lead to further issues.

6. Inspect and clean the nozzle and tail piece. Soaking in an aqueous acid solution is recommended if scale buildup is present. Replace if necessary.

For all 1 ¼" Ejectors:

1. Shut off the gas source and evacuate the system completely.
2. Isolate the ejector on both the water inlet and outlet sides to prevent leakage of water or gases.
3. Disconnect the vacuum line.
4. Disassemble the inlet and outlet water connection unions and remove it from the pipeline. *NOTE: When reinstalling the nozzle and throat, be careful not to overtighten. Overtightening of these parts may result in brakeage or weak points in these parts which could lead to further issues.*
5. Remove the two bolts holding the metal flanges together.
6. Slide the nozzle and throat out the ejector body. Take care not to damage the threaded portion.
7. Inspect and clean the nozzle and throat interior. Soaking in an aqueous acid solution is recommended if scale buildup is present. Replace if necessary.

For all 2", 3" and 4" Flanged Ejectors:

1. Shut off the gas source and evacuate the system completely.
2. Isolate the ejector on both the water inlet and outlet sides to prevent leakage of water or gases.
3. Disconnect the vacuum line.
4. Disassemble the inlet and outlet water line flanges and remove it from the pipeline.
5. Unbolt the flanges from the ejector body and remove the nozzle and throat housing assemblies.
6. Unthread the nozzle and throat from the ejector body. Take care not to damage the threaded portion.
7. Inspect and clean the nozzle and throat interior. Soaking in an aqueous acid solution is recommended if scale build-up is present. Replace if necessary.

SECTION A-II: EJECTOR CHECK VALVES

NOTE: Carefully follow shutdown procedures before performing this repair.

Diaphragm Style Check Valves:

1. Refer to the relevant parts drawing for the ejector.
2. Remove the four bolts holding the two check valve body parts together.
3. Lift the check valve top body away from the check valve bottom body.
4. The check valve O-ring should be replaced. When installing a new check valve O-ring, carefully ensure it is evenly seated in the groove. Lubricating the new O-ring with O-ring grease (e.g. Fluorolube) is recommended for installation. Wipe away all O-ring grease after installation.
5. Inspect the check valve diaphragm for damage (e.g. holes, cracking, etc.). If necessary, unscrew the diaphragm nut and bolt, preferably using a spanner wrench and tongue and groove pliers. Use care not to snap the nut and replace the diaphragm.
6. Replace the spring only if it is damaged.
7. Replace any parts necessary.

8. Reassemble and reinstall the ejector.

Ball Style Check Valves:

1. Refer to the relevant parts drawing for the ejector.
2. Remove and disassemble the check valve assembly to access the ball and sealing O-rings.
3. Replace the O-rings throughout the assembly.
4. The ball and other parts should be inspected and replaced as needed.
5. Replace any parts necessary.
6. Reassemble and reinstall the ejector.

Example ejectors with ball style check valves: EJH-3200-CL, EJH-3120-CL2 and EJH-4120-CL2.

SECTION A-III: EJECTOR DRAIN VALVES

NOTE: Carefully follow shutdown procedures before performing this repair.

1. Review the relevant parts drawings for the drain valve being used.
2. Unthread the valve body parts and separate them.
3. The drain valve O-Ring should be replaced. When installing a new drain valve O-Ring, carefully ensure it is evenly seated in the groove. Lubricating the new O-Ring with suitable lubricant is recommended.
4. Inspect the drain valve diaphragm for damage (holes, cracking, etc.). If necessary, unscrew the diaphragm nut and bolt, preferably using a Spanner wrench and tongue and groove pliers. Use care not to snap the nut and replace the diaphragm.
   NOTE: Soaking the diaphragm assembly in an aqueous acid solution or scale buildup remover may help to free up stuck together parts.
5. Replace the spring only if it is damaged.
6. Replace any parts as necessary.
7. Reassemble and reinstall the drain valve.

Example ejectors with drain valves: EJH-3200-CL, EJH-3120-CL2 and EJH-4120-CL2.

SECTION A-IV: ANTI-SIPHON AND VARIABLE ORIFICE EJECTORS

NOTE: Carefully follow shutdown procedures before performing this repair.

1. Review the relevant parts drawings for the ejector being used.
2. Disassemble and inspect all parts.
3. Replace O-rings, diaphragms, gaskets and any other recommended maintenance parts.
4. Replace any damaged parts as necessary.
5. Reassemble and reinstall the ejector.