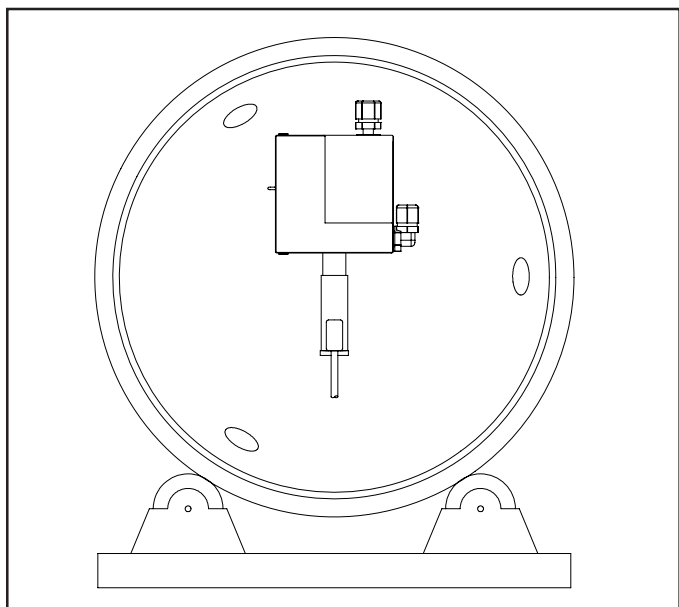
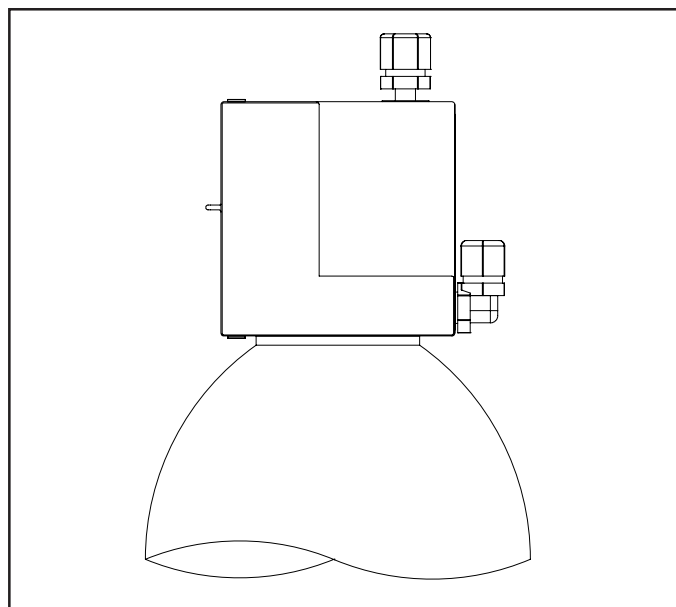


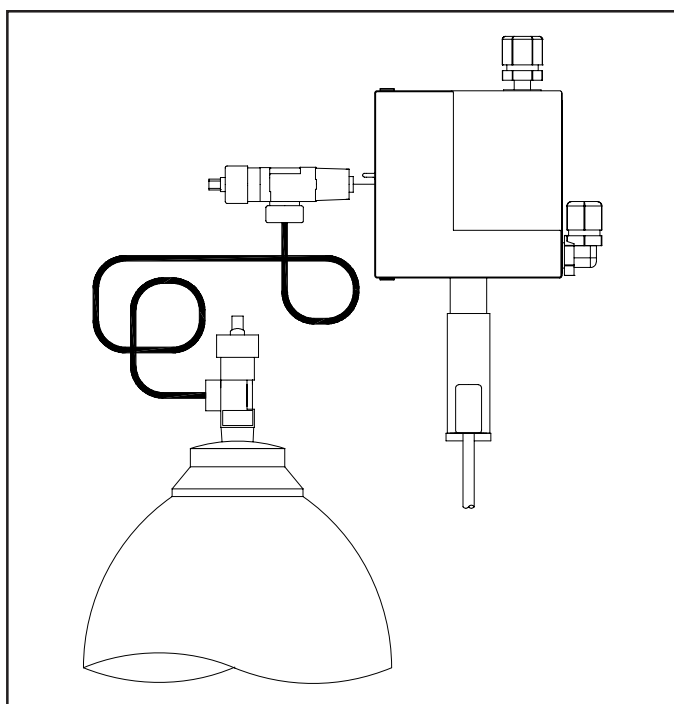
# Instruction Bulletin - Series NXT3000 Cylinder, Ton Container, or Wall Mounted Vacuum Regulator



500 PPD (10 kg/h) Ton Container Mounted



100 PPD (10 kg/h) Cylinder Mounted



Wall Mounted

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These instructions describe the installation, operation and maintenance of the subject equipment. Failure to strictly follow these instructions can lead to an equipment rupture that may cause significant property damage, severe personal injury and even death. If you do not understand these instructions, please call Severn Trent Water Purification for clarification before commencing any work at 215-997-4000 and ask for a Field Service Manager. Severn Trent Water Purification, Inc. reserves the rights to make engineering refinements that may not be described herein. It is the responsibility of the installer to contact Severn Trent Water Purification, Inc. for information that cannot be answered specifically by these instructions.

**Any customer request to alter or reduce the design safeguards incorporated into Severn Trent Water Purification equipment is conditioned on the customer absolving Severn Trent Water Purification from any consequences of such a decision.**

Severn Trent Water Purification has developed the recommended installation, operating and maintenance procedures with careful attention to safety. In addition to instruction/operating manuals, all instructions given on labels or attached tags should be followed. Regardless of these efforts, it is not possible to eliminate all hazards from the equipment or foresee every possible hazard that may occur. It is the responsibility of the installer to ensure that the recommended installation instructions are followed. It is the responsibility of the user to ensure that the recommended operating and maintenance instructions are followed. Severn Trent Water Purification, Inc. cannot be responsible deviations from the recommended instructions that may result in a hazardous or unsafe condition.

Severn Trent Water Purification, Inc. cannot be responsible for the overall system design of which our equipment may be an integral part of or any unauthorized modifications to the equipment made by any party other than Severn Trent Water Purification, Inc.

Severn Trent Water Purification, Inc. takes all reasonable precautions in packaging the equipment to prevent shipping damage. Carefully inspect each item and report damages immediately to the shipping agent involved for equipment shipped "F.O.B. Colmar" or to Severn Trent Water Purification for equipment shipped "F.O.B. Jobsite". Do not install damaged equipment.

**SEVERN TRENT SERVICES, COLMAR OPERATIONS  
COLMAR, PENNSYLVANIA, USA  
ISO 9001: 2008 CERTIFIED**

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# 1 INTRODUCTION

## 1.1 General

The vacuum regulators are engineered and carefully tested to assure years of satisfactory operation. Correct installation and proper care will ensure continued trouble free operation. Read instructions carefully and save for future reference.

This instruction manual covers the *NXT3000* Series vacuum regulator and it's function within a gas feed system. The complete gas feed system consists of a vacuum regulator, a gas meter assembly with a manual or automatic rate valve and an ejector. Refer to the following instruction manuals for other system components:

Meter Assemblies 100.6702

Ejectors 122.6001, 122.6006, 122.6010, 122.6060

Also, the following literature is referenced throughout:

Changing Gas Cylinders Instruction Card 24563.1

Vacuum Line Size Requirements 100.4601

Chemical feed equipment technical information 010.3650

## 1.2 Warranty

See Bulletin 005.9001 for Severn Trent Services equipment warranty.

NOTE: The *NXT3000* vacuum regulator is designed for use in systems where the feed rate is manually or automatically set and operation is either continuous or start/stop. The Severn Trent Services equipment warranty and service policy is null and void, as it pertains to user protection, if the *NXT3000* Series vacuum regulator is misapplied.

## 1.3 Standard Equipment

The *NXT3000* Series gas feeder system consists of the following major components and accessories:

- 1.3.1 Vacuum regulator, which connects to the gas container valve or a gas manifold.
- 1.3.2 Ejector assembly. See Instruction Manuals 122.6001, 122.6006, 122.6010, 122.6060.
- 1.3.3 Metering or multiple feed points, separate meter assemblies. See Instruction Manual 100.6702.
- 1.3.4 Accessories
  - a. (1) - chlorine cylinder/container valve wrench.
  - b. (1) - O-ring lube
  - c. (1) - Poly leak detector squirt bottle
  - d. (6) - Inlet valve filter pads
  - e. (1) - Vent tubing insect screen
  - f. (4) - Lead valve gaskets
  - g. (1) - 1/2" NPT to 5/8" tubing elbow
  - h. 25 FT - 5/8" tubing
  - i. (2) - 1/2" NPT x 3/8" tubing connector
  - j. (1) - 1/4" NPT x 1/2" tubing connector
  - k. (1) - Bushing, 1/2" MNPT x 1/4" FNPT

**NOTE:** This instruction manual covers the vacuum regulator only. Since the vacuum regulator is one part of a gas feed system, references will be made within this bulletin to meter assemblies, ejectors and other ancillary equipment that complete the various systems. Installation of a complete system is covered within.

## 1.4 Specifications

<b>Capacity:</b>	Chlorine -	1 to 500 PPD (20 g/h to 6 g/h)
	Sulfur Dioxide -	1 to 500 PPD (20g/h to 10 g/h)
	Ammonia -	5 to 250 PPD (30 g/h to 5 g/h)
	Carbon Dioxide -	0.75 to 375 PPD (15 g/h to 7 kg/h)

The maximum delivery capacity is dependent upon the mounting location of the vacuum regulator and the ambient temperature. These capacities are listed in Table A for an ambient temperature of 70°F to 5°F.

Gas Being Handled	Vacuum Regulator Mounting Location		
	Wall	Ton Container	Cylinder
Chlorine or Sulfur Dioxide	500 lb/d 10 kg/h	500 lb/d 10 kg/h	100 lb/d 2 kg/h
Ammonia	250 lb/d 5 kg/h	NA	NA
Carbon Dioxide*	375 lb/d 7 kg/h	NA	NA

\*Due to the high gas pressure in the carbon dioxide storage cylinders, a two stage pressure regulator is required between the gas source and the vacuum regulator.

Temperature limits:	35° to 130°F (2° to 54°C)
Maximum inlet pressure:	300 PSIG
Manifold heater power:	25 Watt, 120 or 240 VAC, 50/60 Hz

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## 2 OPERATION

### 2.1 General

#### A. Vacuum Regulator

The vacuum regulator serves to reduce the supply pressure in a gas cylinder or ton container to a regulated vacuum for safe transport of the gas to the point of application. A leak in any portion of the vacuum transport line simply allows air to be pulled into the system. A substantial vacuum line break will stop gas feed from taking place. The vacuum regulator is a spring opposed diaphragm type that resumes vacuum to operate the gas inlet valve. The vacuum regulator can control gas flow rates from 1 to 500PPD without any component changes.

For manually controlled systems, the flow rate of gas through the regulator is set and indicated by a meter assembly which contains a manually adjusted needle valve, called a rate valve. One or more meter assemblies may be furnished with each vacuum regulator and they may be either integrally mounted on the vacuum regulator or wall mounted, as required. The operating vacuum that pulls the gas through the system is created by a separately mounted ejector, one normally being required for each meter assembly.

Each vacuum regulator is equipped with a vacuum actuated, manually reset, three position, "status" lever marked RESERVE, OPERATING, and EMPTY. When a system is placed into operation, the lever is manually set to the operating position. When the gas in the cylinder or ton container is exhausted, or has been inadvertently interrupted, the lever automatically moves to the EMPTY position. The RESERVE position is used when a dual regulator type gas dispensing system is furnished. The RESERVE position indicates that the gas cylinder is full and is in stand-by condition. When the operating tank is exhausted, its status lever moves to EMPTY and the reserve tank status lever moves to the OPERATING position. This provides an automatic changeover of gas feed from the exhausted to the full gas supply container.

#### B. Meter-Rate Valve Assembly

The meter assembly is a variable area type meter and provides visual indication of the gas flow rate set by the rate valve.

The rate valve is located at the meter outlet (top) to provide manual selection of the desired gas flow rate.

The capacity range of each meter-rate valve assembly is clearly indicated by a calibrated scale, direct reading in pounds per day (lb/d) and grams per hour (g/h) or kilograms per hour (kg/h), etched on the meter assembly tube.

For systems requiring automatic feed control, an automatic valve is provided to be piped between the ejector and the meter assembly. The manual valve on the meter assembly is not supplied for this mode of operation.

#### C. Ejector

The ejector, operated by the flow of water or process liquid under sufficient pressure and velocity, creates the necessary vacuum to operate the regulator. In some instances, a booster pump is required to provide sufficient water pressure and flow rate.

### 2.2 Safety Features

The gas inlet valve of the vacuum regulator provides positive shut-off in the absence of operating vacuum. Therefore, the regulator is sealed off from the gas supply if a major leak should develop in the vacuum portion of the gas dispensing system during normal operation or at shutdown when the water supply to the ejector is shut off. This valve is protected by a mesh type filter located within the gas inlet connection.

A pressure relief valve, within the vacuum regulator, provides for venting gas, through a vent connection, to a remote and suitable location should gas at greater than atmospheric pressure enter the regulator. This abnormal condition could occur as liquid chemical enters the regulator; or, the gas inlet valve of the regulator does not close tightly due to the accumulation of foreign matter not removed by the filter.

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The manifold assembly, supplied with wall and ton container mounted regulators, has a liquid chemical trap, an wrap-around type heater and a cartridge type filter. The trap catches any condensed gas vapors (liquid chemical) which may form in the gas supply line of a wall mounted unit or the small volume of liquid chemical discharged through the gas valve of a ton container each time a new container is placed in service to prevent its entrance into the regulator. The heater vaporizes any liquid chemical and prevents any gas from condensing in the manifold, thereby permitting only gas to enter the regulator. The filter cartridge serves to remove entrained foreign particles from the gas entering the manifold assembly, thereby reducing the solids loading on the mesh type filter located in the gas inlet connection of the regulator.

## 2.3 Principle of Operation

When the ejector is operating, gas enters the regulator, being reduced from supply pressure to a constantly regulated vacuum by the throttling action of the regulator, the meter assembly rate valve assembly and into the ejector. Within the ejector, the gas is thoroughly mixed with the water or process liquid to form a chemical solution which is delivered via solution hose or piping to the point of application.

### **WARNING**

**All components of the gas dispensing system are constructed of materials capable of withstanding the corrosive action of the particular gas for which the system has been specified. Never attempt to use any component for handling a gas different from that for which it has been purchased. Failure to observe this warning can result in equipment failure and bodily injury.**

## 2.4 Capacity

Each vacuum regulator has the maximum feeding capacity of 500PPD of chlorine. The actual system maximum is determined by the flowmeter-rate valve combination and the commensurate ejector sizing. The capacity of an installed system may be changed by changing the meter assembly and/or ejector capacity components. Refer to the meter assembly parts list, 100.7602 and ejector parts lists, Section 122 for the specific part numbers associated with each ejector.

## 2.5 Typical Gas Feed Systems

Figure 1 illustrates several basic system arrangements. The meter-rate valve assembly may be mounted directly on the vacuum regulator or remotely on a wall. The meter assemblies have the ability of being ganged with the actual total gas flowrate limited by the 500PPD capacity of the vacuum regulator for up to five separate feed points. A mix of automatic and manual feed points are also possible as the gas feed processes dictate.

Automatic switchover may be achieved by adding a second vacuum regulator and connecting the outlets to a tee connected to the meter assemblies and following the procedures outlined further in this manual.

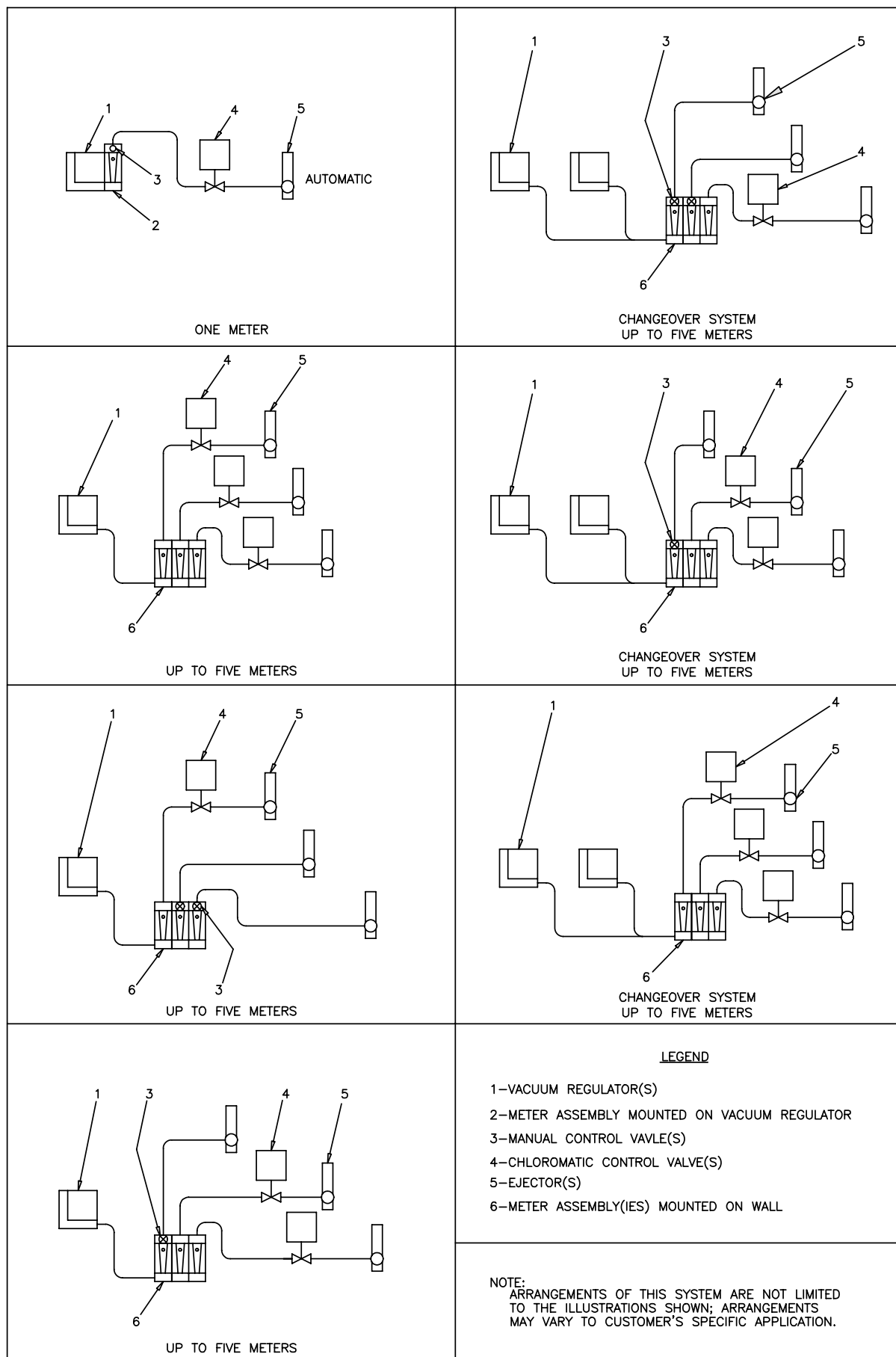


Figure 1 - Basic System Schematics



### 3 INSTALLATION

Select a location which can be isolated from unauthorized personnel. Outdoor installations for cylinder or ton container mounted regulators are permissible provided that the ambient temperature will not fall below 35°F (2°C) for chlorine and ammonia systems; or, 40°F (5°C) for sulfur dioxide systems. Outdoor installations for wall mounted regulators are not recommended (especially if the gas supply system consists of two or more containers) since a sudden decrease in ambient temperature will result in the formation of condensed gas vapors (liquid chemical) in the gas supply line. This liquid will be swept into the manifold and if sufficient in volume to exceed the vaporizing capacity of the manifold heater, will flood the manifold and enter the regulator.

#### CAUTION

**The corrosion resistant plastics used in the construction of all regulators and meter-rate valve assemblies, regardless of the particular gas service for which they have been supplied, will soften and distort above 130°F (54°C). Therefore, the ambient temperature, in every instance, must never exceed this maximum allowable limit.**

For outdoor installations, select an area which will provide natural protection for the gas supply against direct sunlight. If this is not possible, erect an open type structure to provide this protection. Observe the upper and lower temperature limits.

For indoor installations, select a well ventilated enclosure provided with a source of heat, if necessary, to maintain, a comfortable ambient temperature. Additionally, the enclosure should be of sufficient size to permit easy access for inspection and maintenance of the regulator and gas supply. And finally, to provide for maximum safety of operating personnel, the enclosure should be equipped and fitted as described under the Personnel Safety Section of Instruction Bulletin 010.3550.

The relative locations of the regulator(s); the remote mounted meter-rate valve assemblies, if used; and the ejector(s) must be chosen so that the length(s) of the vacuum line(s) does not exceed the value(s) shown in the appendix. Maximum gas flow to the point(s) of application will not be achieved if these limits are exceeded. Therefore, it will be necessary to refer to the appendix before locating the components of the system to verify that the length of each interconnecting vacuum line (and vent line) when the regulator is mounted on a cylinder valve or the gas valve of a ton container to permit easy transfer of the regulator from one cylinder or container to another. Arrange all vacuum lines to prevent crimping.

The vent line(s), one required for each regulator, must be extended to a suitable area (outside the building for indoor installations) where gas fumes cannot cause damage or endanger personnel. Although there is no restriction (within practical limits) to the distance over which the vent line(s) can be extended, each line, if applicable, must be run individually. Multiple vent lines cannot be manifolded. The vent line must slope downward from the vacuum regulator to provide a positive drain, preventing accumulation of any moisture in the vent line. The end of the vent line(s) must be turned downward to prevent the entrance of water. The fine mesh plastic screen(s) (supplied in the accessory package) must be installed over the outlet(s) to prevent insects from entering the line(s).

When extending vent lines, eliminate low spots to prevent trapping condensed water vapor and arrange to prevent crimping.

All threaded plastic-to-plastic pipe joints must be lubricated to prevent galling of the threads, provide a perfect seal and to permit ease of disassembly. The recommended lubricating agent is Teflon (self lubricating) tape. Apply tape to the male pipe threads, one thread from the end, only to prevent it from entering the piping. Exercise care not to overtighten the joints as this may crack the plastic. Slightly more than hand tight is usually sufficient.

The vacuum regulator can be direct mounted to a 150 lb cylinder, ton, container wall mounted or mounted on a multi-container manifold.

Cylinder Mounting refer to Figure 4.

Ton Container Mounting refer to Figure 5.

Wall Mounting refer to Figure 6.

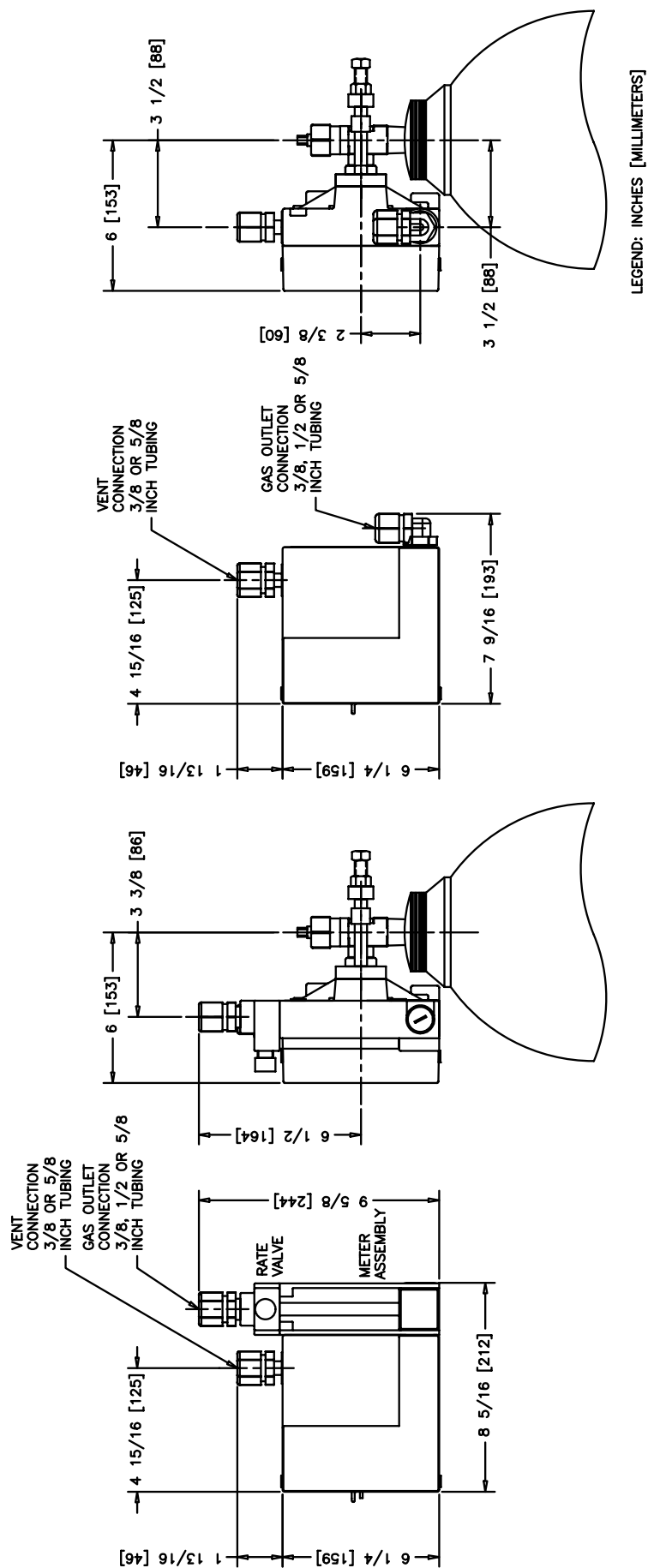


Figure 2 - Cylinder Mounted Vacuum Regulators



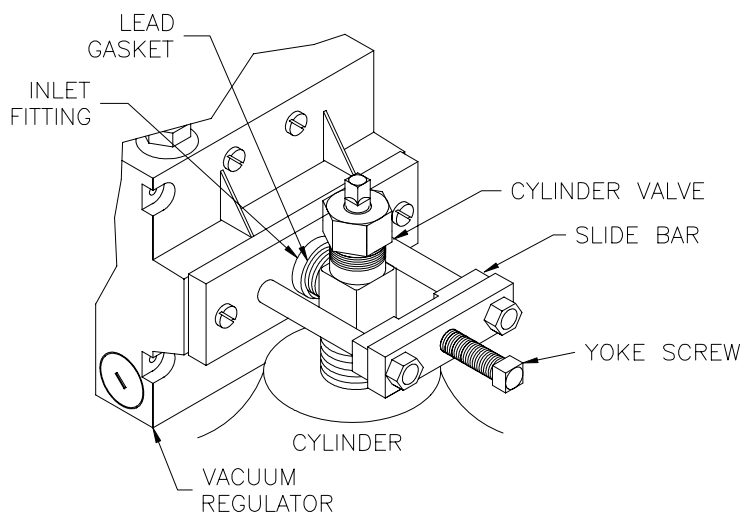
1. HEATER FURNISHED WITH 10 FOOT [3 m] CORD AND 3 PIN PLUG. 120 VOLT, 60 HZ, SINGLE PHASE REQUIRED TO OPERATE HEATER
2. FILTER ACCESS COVER
3. FOUR 5/16 [8] WIDE SLOTS PROVIDED FOR WALL MOUNTING. MOUNTING HOLE LOCATIONS ARE GIVEN IN THE INSTRUCTIONS BELOW.
4. OPTIONAL: TWO INCH [51] DIAL GAS PRESSURE GAUGE WITH CHEMICAL PROTECTOR

LEGEND: INCHES [MILLIMETERS]

WITH INTEGRALLY MOUNTED METER RATE VALVE ASSEMBLY

WITHOUT INTEGRALLY MOUNTED METER RATE VALVE ASSEMBLY

Figure 3 - Ton Container and Wall Mounted Vacuum Regulators



**NOTE:**

Ideally, a second full RESERVE cylinder should be positioned and secured close to the OPERATING cylinder. This will permit ease of transfer of the regulator to the RESERVE cylinder when the OPERATING cylinder becomes exhausted. If space limitations prevent this, install an ordinary coat hook (of suitable size) on a nearby wall. Then, when changing cylinders, hang the regulators on the wall by slipping its yoke over the hook.

**PROCEDURE FOR MOUNTING:**

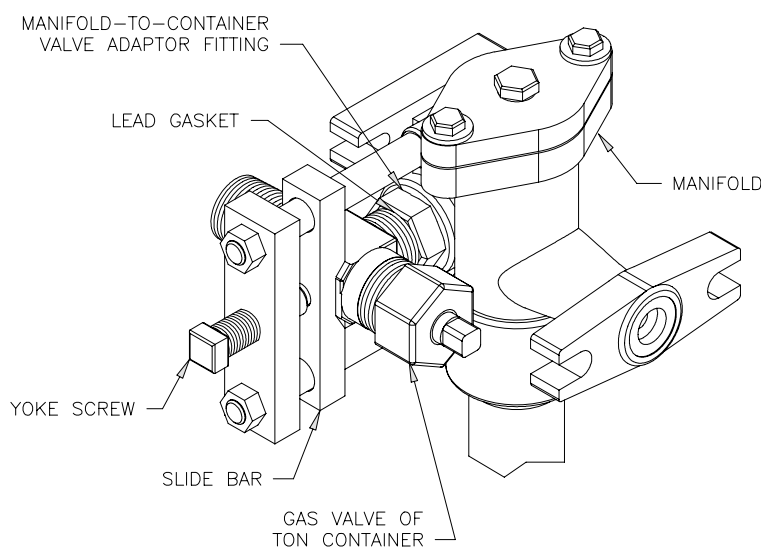
1. Place the cylinder in an upright position and secure by chaining or tying to a solid support to keep it from tipping or falling.
2. Remove the valve protective hood.
3. Remove the cap from the cylinder valve.
4. Loosen the yoke screw and move the slide bar to its full open position.
5. Install a new lead gasket in the inlet fitting of the regulator.

**WARNING**

**Remove any used lead gaskets; only one gasket should be used at a time. DO NOT REUSE GASKETS. Gas is under pressure at this point and leaks could result in bodily injury.**

6. Slip the yoke over the cylinder valve, seat the cylinder valve outlet in the inlet fitting and tighten the yoke screw securely using a wrench, but do not overtighten.
7. Check for leaks and retighten the connection as necessary or replace with a fresh washer.

Figure 4 - Mounting Cylinder Mounted Vacuum Regulators



**PROCEDURE FOR MOUNTING**

1. Remove the protective hood to expose the valves.
2. Position the ton container so that the valves are in a vertical position, one above the other, and chock or cradle to prevent it from rolling.

**WARNING**

In the mounting position described in step 2, the upper valve will discharge gas and is the connection to be used for the gas dispensing system. The lower valve (if opened) will discharge liquid chemical and could result in bodily injury.

3. Remove the cap from the upper (gas) valve.
4. Loosen the yoke screw and move the slide bar to its full open position.
5. Install a new lead gasket in the adaptor fitting in the manifold.

**WARNING**

Remove any used lead gaskets; only one gasket should be used at a time. Gas is under pressure at this point and leaks could result in bodily injury.

6. Slip the yoke over the gas valve, seat the gas valve outlet in the adaptor inlet and tighten the yoke screw securely using a wrench, but do not overtighten.
7. Check from leaks and retighten the connection as necessary or replace with a fresh washer.

**NOTES:**

1. If the gas valve outlet faces opposite to the direction illustrated, reverse the positions of the mounting yoke, adaptor fitting and plug. Reseal the threads of the adaptor and plug using teflon tape.
2. Ideally, a second full RESERVE ton container should be positioned and secured close to the OPERATING ton container. This will permit ease of transfer of the regulator to the RESERVE container when the OPERATING container becomes exhausted. If space limitations prevent this, install an ordinary coat hook (of suitable size) on a nearby wall. Then, when changing containers, hang the regulator on a nearby wall by slipping its yoke over the hook.

Figure 5 - Mounting - Ton Container Mounted Vacuum Regulators

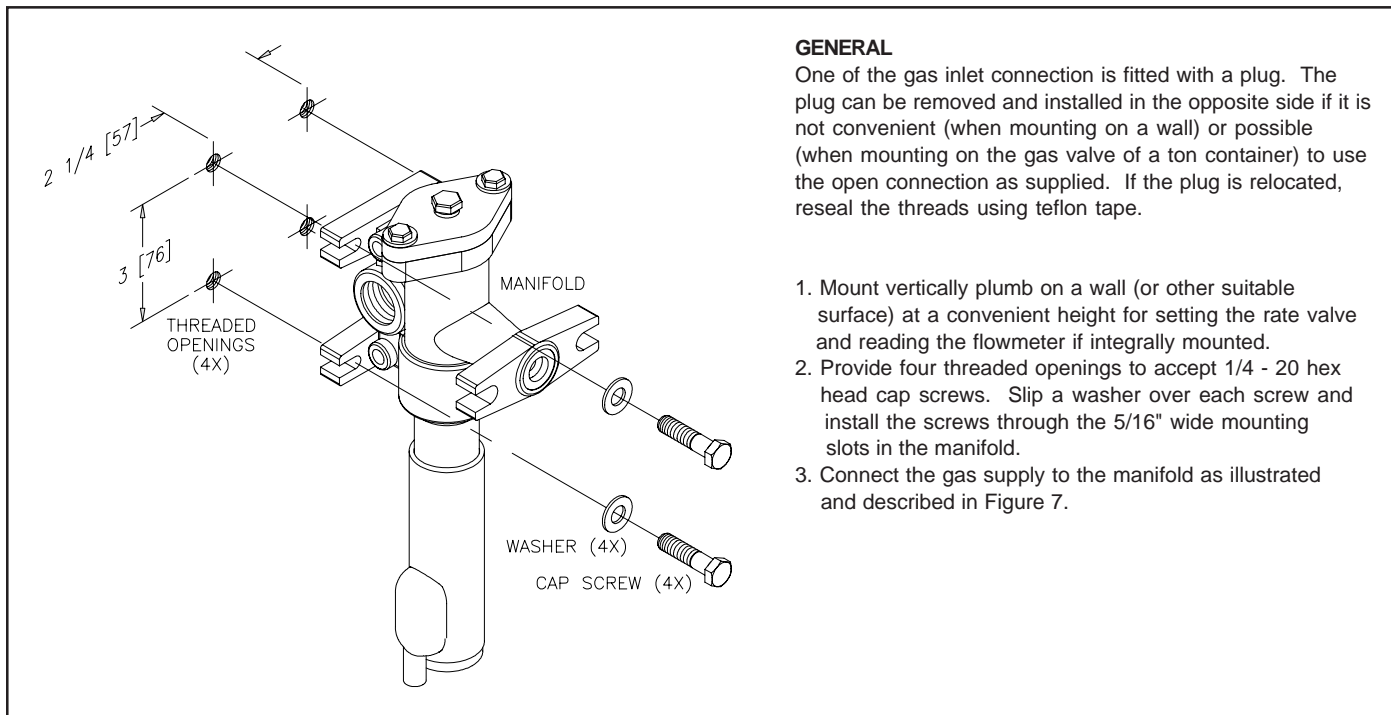
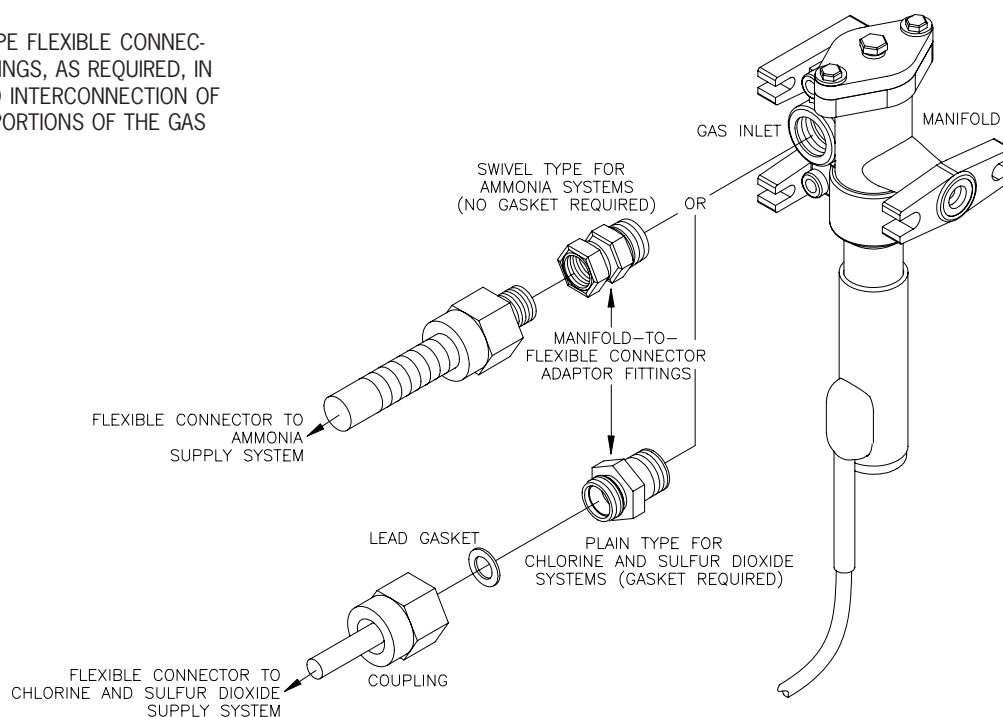


Figure 6 - Mounting - Wall Mounted Vacuum Regulators

**NOTE:**

USE ONLY APPROVED TYPE FLEXIBLE CONNECTORS AND ADAPTOR FITTINGS, AS REQUIRED, IN THE CONSTRUCTION AND INTERCONNECTION OF ALL FLEXIBLE PIPE RUN PORTIONS OF THE GAS SUPPLY SYSTEM

**PROCEDURE FOR CONNECTION TO THE GAS SUPPLY SYSTEM**

1. The manifold is provided with an appropriate adaptor fitting for the intended gas service.
2. A second adaptor fitting may be added only in those instances where the gas supply system consists of two supply containers. It is installed (and sealed) in the alternate (normally plugged) gas inlet connection of the manifold. If isolation of the flexible connectors is desired, an isolating valve may be inserted into each of the manifold gas inlet ports in lieu of the manifold-to-flexible connector adaptors.

For three or more container systems the manifold is installed (and sealed) in the outlet connection of a header, which serves to complete the interconnections to the multiple supply containers.

3. Install the gas supply system (and complete the inter-connection between the system and the gas inlet) only after becoming thoroughly familiar with the information provided in Instruction Bulletin 010.3650 concerning gas supply containers, gas supply lines and interconnection practices. The gas supply header, if required, must be constructed of Schedule 80 3/4" seamless steel pipe with 3000 lb forged steel fittings.

**WARNING****Failure to observe these warnings can result in bodily injury.**

Flexible connectors must be arranged in a smooth spiral to prevent kinking. Kinks cause mechanical damage which will result in immediate or eventual rupture. Connectors so damaged, either during shipment, handling or at time of installation must never be used.

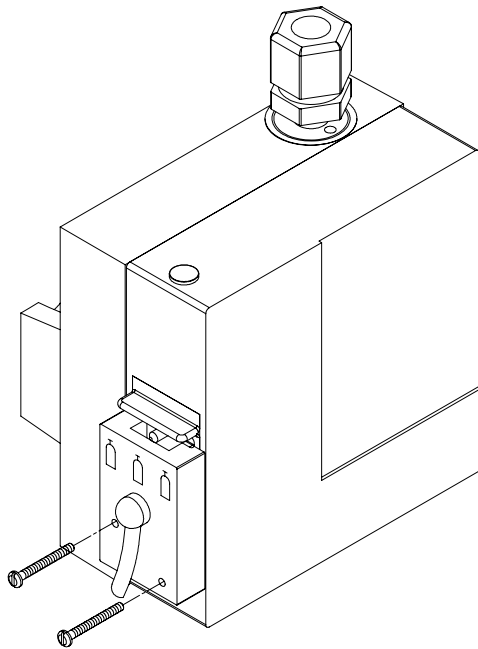
Cylinders must be placed in an upright position (with the valve at top) and secured by chaining or tying to a solid support to keep them from tipping or falling.

Ton containers must be positioned so that their valves are in a vertical position, one above the other, and chocked or cradled to prevent them from rolling. In this position, the upper valve will discharge gas; the lower valve will discharge liquid chemical. Therefore, be absolutely certain to connect to the upper (gas) valve.

**CAUTION**

Each flexible connector should be arranged in a smooth curving slope (avoiding traps) and pitched back toward the container(s). This arrangement will permit condensed gas vapors (liquid chemical) that may form in the connector(s), or gas supply header, if present, to flow back into the container(s).

Figure 7 -Connections - Wall Mounted Vacuum Regulators



An optional, field mountable, switch is available for remote indication of a loss of gas supply. The switch may be attached directly to the vacuum regulator body without disassembling the body. Refer to Instruction Bulletin 100.6703 and parts list 100.7603 for further details. The kit P/N is 674B093U02

Figure 8 - Out-of-Gas Alarm Switch

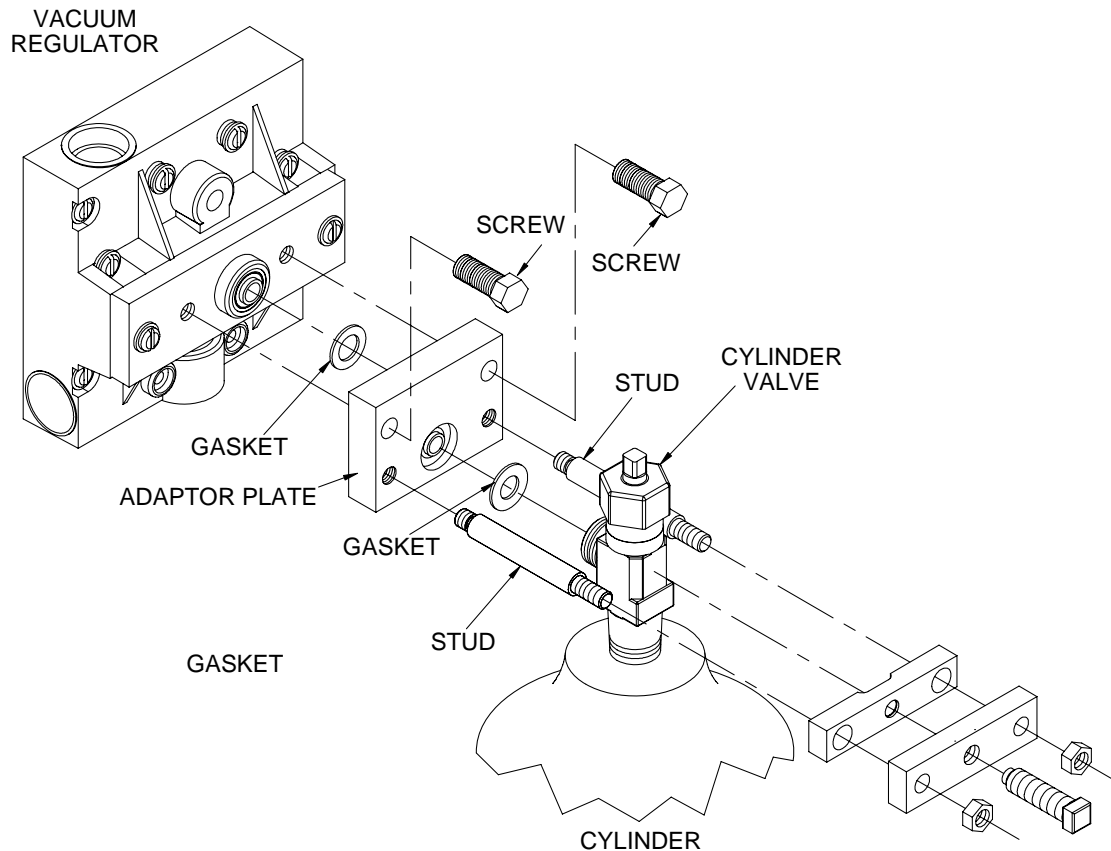


Figure 9 - SO<sub>2</sub> Cylinder Adaptor Plate

## Accessories:

**Manifold Adaptor Kits:** Manifold adaptor kits are available to convert the cylinder mounted vacuum regulator to either ton container or wall mounting.

Wall mounting kit P/N 19558

Ton container mounting kit P/N 19560

Refer to parts list 100.7606 for detailed parts listing.

## Wall Mounted Vacuum Switches

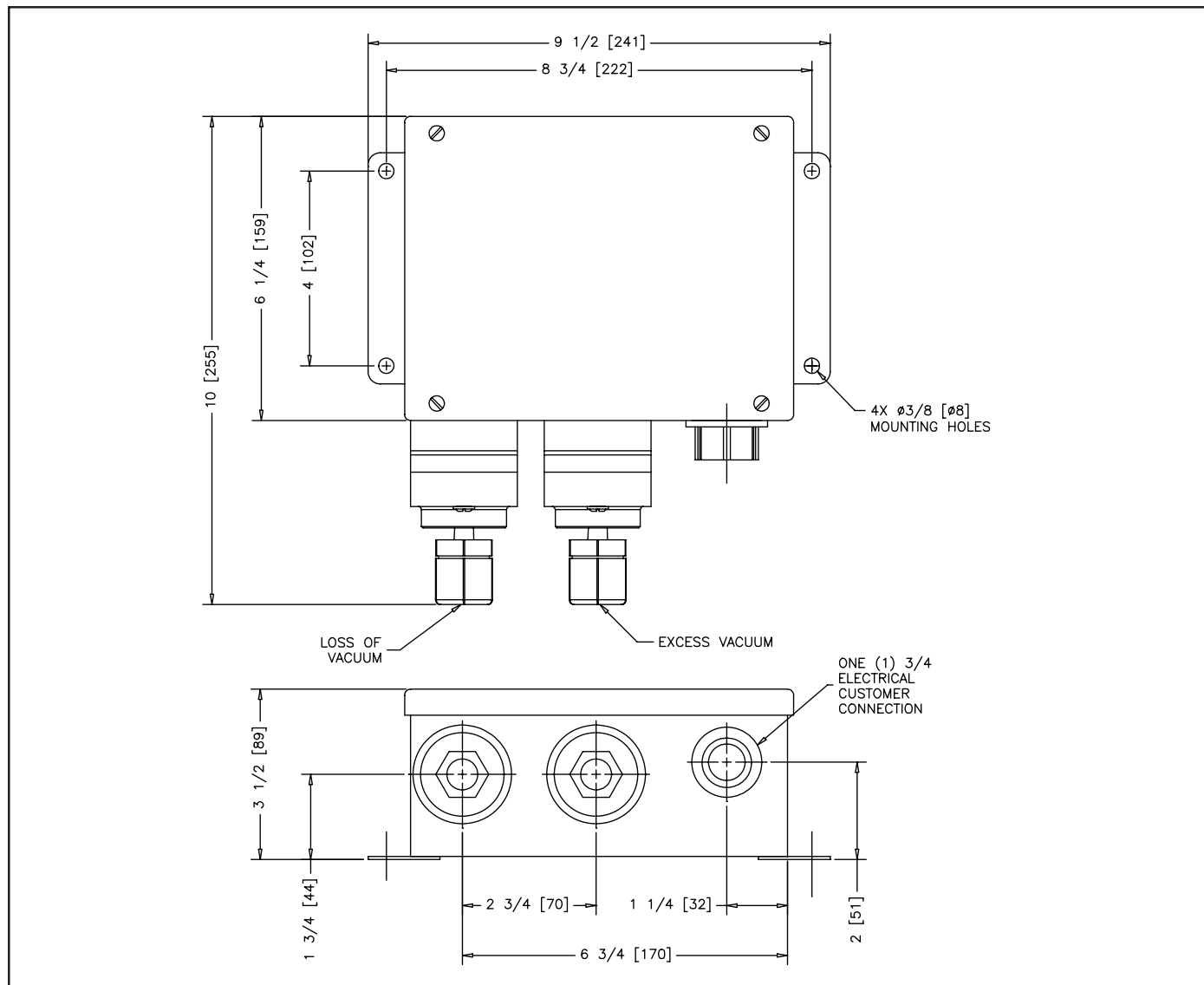


Figure 10 - Wall Mounted Vacuum Switches

Wall mounted Nema 4X vacuum switches are available for remote indication of out of spec vacuum conditions.

Low vacuum only (loss of ejector operation, break in vacuum line), P/N 806L051U02.

High vacuum only (out of gas, gas source valve closed), P/N 806L051U06.

Both high and low vacuum switches, P/N 806L051U03.

Note: Low vacuum is measured at the vacuum line coming from the ejector and high vacuum is measured at the vacuum line between the vacuum regulator and the meter assembly.

## SafeTC Container Valve Shut-off System

An automatic emergency cylinder valve shut-off system is available. Refer to specification sheet 140.0005 for more details.



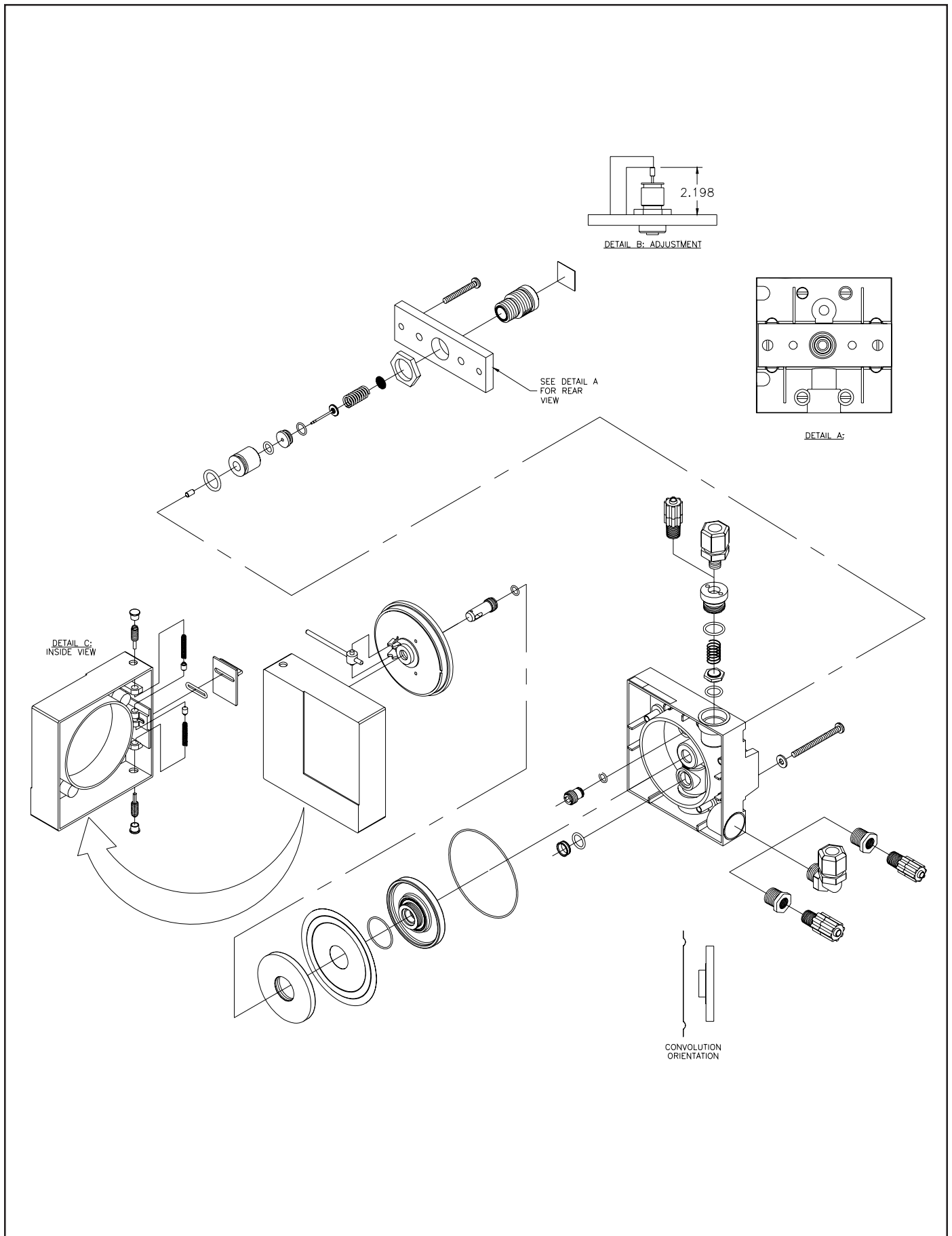


Figure 11 - Vacuum Regulator Exploded View

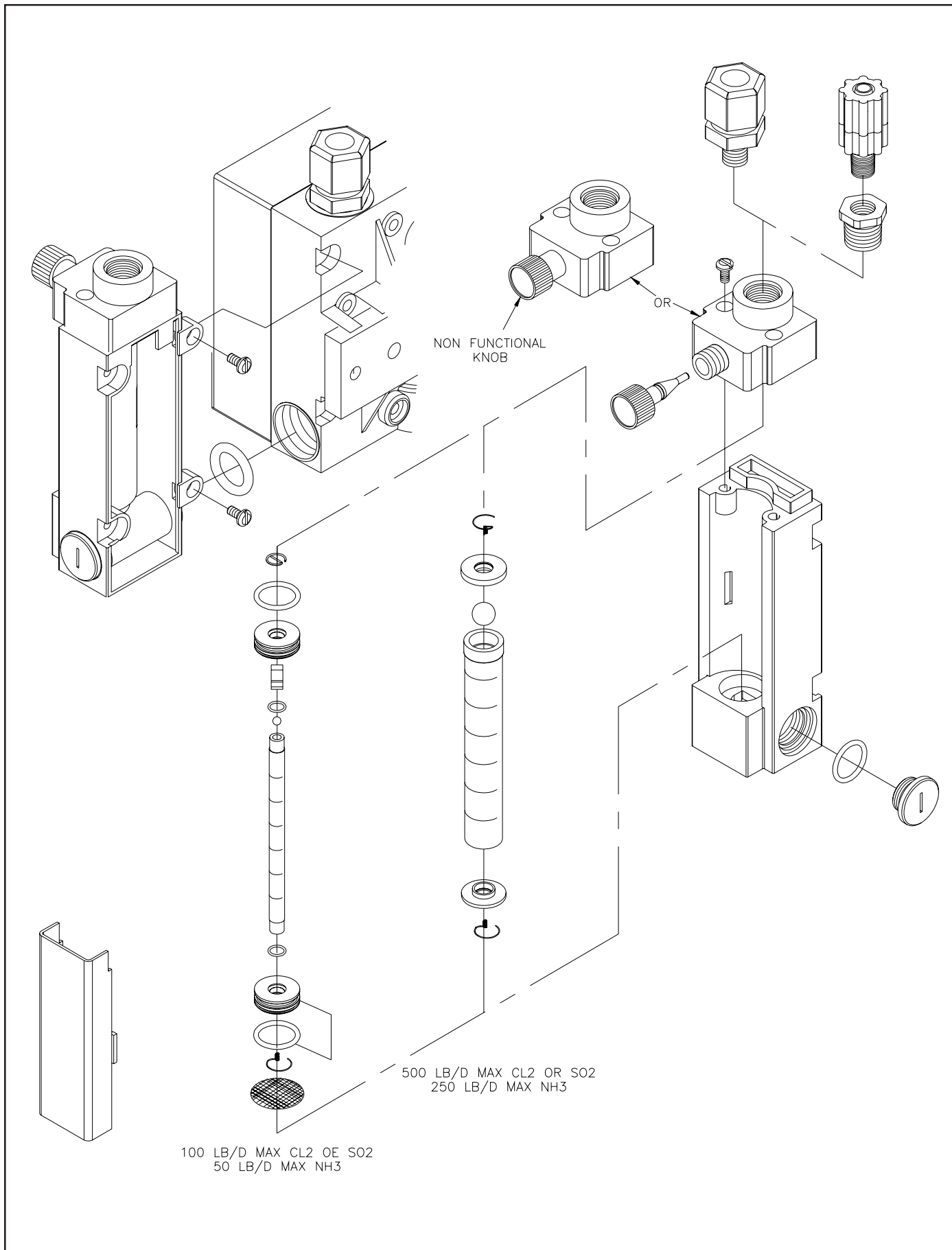


Figure 12 - Meter Exploded View

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## 4 OPERATING INSTRUCTIONS

### 4.1 Initial Start-Up

Prior to start-up after an extended shutdown, inspect all lines and connections, making replacements as necessary. If lines are transparent, inspect for blockage. Disconnect any blocked line and clean by blowing down. If lines cannot be visually inspected, disconnect the lines and blow down to make certain no blockage exists. **DO NOT PRESSURE TEST THE VACUUM LINES AS EQUIPMENT DAMAGE WILL RESULT.**

#### A. Checking for Operating Vacuum

1. Remove the vent valve spring and flapper located on the top of the vacuum regulator.  
If the gas dispensing system is of the dual regulator type, perform this action on the furthest remote mounted regulator since one of the purposes of this procedure is to establish that the length of the vacuum line(s) do not exceed the maximum allowable transport distance.
2. Move the "status" lever located on the side of the regulator to its OPERATING position. Be sure that the valve on the gas container is closed during this procedure.  
If the gas dispensing system is of the dual regulator type, perform this action on both regulators since another purpose of this procedure is to establish that the connection(s) to or throughout the gas supply system(s) have been properly made and secured.
3. Open any shut-off valves in the chemical solution line between each ejector and its point of application.
4. Open the shut-off valve in the water supply line to each ejector and start up the booster pump(s), if used.
5. Gradually open the rate valve of each meter-rate valve assembly while observing the upward movement of the meter assembly float. On systems with an automatic valve, manually operate the valve while observing the meter assembly float.

The gas dispensing system is now operating on air being drawn through the vent. Sufficient ejector operating vacuum to provide maximum operating capacity for the complete system is verified when each meter-valve assembly can be operated simultaneously on air at approximately;

- a) 50% or higher of max-scale position for chlorine and sulfur dioxide systems; and, b) 25% or higher of max-scale position for ammonia systems.

If the meter assembly float does not rise or if the required air flow rate is not achieved in each assembly the first time, the gas dispensing system is placed in operation, refer to Trouble "A" in the troubleshooting chart to determine the probable cause(s) and corrective action(s) to be taken. If either of these conditions occur on subsequent start-ups (e.g.: following an extended period of servicing shutdown), refer to Trouble "B" in the troubleshooting chart to determine the probable cause(s) and corrective action(s) to be taken.

6. Replace the vent valve spring and flapper, sparingly lubricate the threads (if necessary) to provide a perfect seal. Do not apply any lubricants to the seat seal o-ring or the vent valve seat.
7. With the system dead-ended; a) the float of each meter-rate valve assembly should fall to zero, and b) the "status" lever located on the side of the regulator(s) should move to the EMPTY position (the closed valve shows the same response as an empty gas container).

If either of these conditions do not occur, check that the connection(s) to or throughout the gas supply system, associated with the regulator(s) failing to exhibit the proper response, have been properly made as described and illustrated in Figures 4,5, or 7.

If the occurrence of these conditions cannot be traced to a faulty connection, refer to Trouble "C" or Trouble "D". Trouble "C" in the troubleshooting chart can determine other probable cause(s) and corrective action(s) to be taken if this is placed in operation. Trouble "D" in the troubleshooting chart can determine other probable cause(s) and corrective action(s) to be taken on subsequent start-ups (e.g.: following an extended period or servicing shutdown).

8. When the system exhibits the requirements set forth in steps 5 and 7, shut off the water supply to the ejector(s).

## B. Checking for Gas Leaks

### 1. General

The test solution to be used in each of the following procedures is dependent upon the gas being handled. Use a 26°Baume' (ammonium hydroxide, aqua ammonia) ammonia solution for chlorine and sulfur dioxide systems and a 10% hydrochloric (muriatic) acid solution for ammonia systems.

**NOTE:** Household ammonia is not strong enough to serve as a test solution.

If the gas dispensing system is of the dual regulator type, be certain to perform the "Checking for Gas Leaks" procedure(s), as applicable, and independently, on each of the associated gas supply systems in question.

#### **WARNING**

**During the performance of the "Checking for Gas Leaks" procedure(s), as applicable, be certain to use plastic or rubber gloves to protect the hands against direct contact with the test solution. Avoid breathing fumes emitted from the test solution and the smoke formed (as a result of the chemical reaction which occurs between the fumes of the test solution and the gas in question) in the immediate vicinity of a leak as it may irritate the throat.**

The gas inlet valve is functional when the "status" lever located on the side of the regulator is in its EMPTY position. The lever automatically assumes this position during the occurrence of a high vacuum condition within the regulator. For example, when the system is dead-ended at the conclusion of the "checking for operation vacuum" procedure; or, when the supply of gas becomes exhausted during the course of normal operation. Therefore, it is not necessary to move the lever to its operating position prior to, or during, the performance of the "Checking for Gas Leaks" procedure(s). In fact, it will be impossible to do so following the "Checking for Gas Leaks" procedure, at which time the lever becomes "vacuum locked" in its EMPTY position and will remain so until gas pressure is applied to the gas inlet connection of the regulator; i.e., either during or at the conclusion of the performance of each of the following procedures.

### 2. Cylinder Mounted Vacuum Regulators

- Fill the plastic squirt bottle, supplied in the accessory kit, approximately 25-50% full with the appropriate test solution and replace the cap/nozzle.
- Momentarily, partially open the cylinder valve to pressurize the connection and close the valve tightly. Direct the nozzle at the joint to be tested and squeeze the bottle to expose the joint to the test solution vapors. Do not squirt any *liquid* test solution on the process piping as this will produce corrosion damage to the piping.
- If the connection leaks, turn on the water supply to the ejector(s) for several minutes to evacuate the small volume of entrapped gas, then shut off. Correct the leak by tightening the yoke screw and repeat the pressure test. If the leak persists, replace the gasket and repeat the pressure test.
- When the connection is secured, close the cylinder valve and proceed to Section II. Operation.

#### **CAUTION**

**Cylinder valves should not be opened more than one full turn.  
Opening beyond this point may result in valve damage.  
One full turn will permit maximum flow through the valve.  
Opening the cylinder valve less than one full turn may limit the flow and could frost the process piping.**

### 3. Ton Container Mounted Vacuum Regulators

- Fill the plastic squirt bottle, supplied in the accessory kit, approximately 25-50% full with the appropriate test solution and replace the cap/nozzle.

- b. Connection of a vacuum regulator to a ton container requires additional care, at start-up time, as liquefied gas **will** be present in the gas eduction tube of the ton container. Plug in the manifold heater and be sure that the manifold is hot to the touch. Initially the container gas valve should be opened and closed quickly to pressurize the system in order to perform a leak test. Direct the nozzle of the squirt bottle at the joint to be tested and squeeze the bottle to expose the joint to the test solution vapors. Do not squirt any *liquid* test solution on the process piping as this will produce corrosion damage to the piping. A leak at this connection will be revealed by the formation of a dense white smoke.
- c. If leaks are found, immediately turn on the water supply to the ejector(s) to evacuate the manifold, and at time of initial start-up or start-up following an extended shutdown period, plug in the heater to aid in the evacuation process.

Continue to operate the ejector(s) until the meter-rate valve assembly falls to zero, indicating that the manifold is evacuated. (It may take several or more minutes to complete the evacuation, since a small volume of liquid chemical trapped in the eduction pipe inside the container, will be blown into the manifold each time a full container is place in service.) When the manifold is evacuated, shut off the water supply to the ejector(s). Correct all leaks and repeat the pressure test. If a leak occurs around the gasket seal at the inlet to the manifold which cannot be corrected by simply tightening the yoke screw, it will be necessary to replace the gasket and repeat the pressure test.

- d. When the connection is secured, open the container valve one full turn and proceed to Section II. Operation.

**CAUTION**

**Cylinder valves should not be opened more than one full turn.  
Opening beyond this point may result in valve damage.  
One full turn will permit maximum flow through the valve.  
Opening the cylinder valve less than one full turn may limit  
the flow and could frost the process piping.**

**4. Wall Mounted Vacuum Regulators**

- a. Fill the plastic squirt bottle, supplied in the accessory kit, approximately 25-50% full with the appropriate test solution and replace the cap/nozzle.
- b. Before performing any of the test procedures be sure that the manifold heater is plugged in and the heater/manifold is hot to the touch. Additional care should be exercised when ton containers are utilized as the gas source as liquefied gas **will** be present in the gas eduction tube. Initially the container gas valve should be opened and closed quickly to pressurize the system in order to perform a leak test. Direct the nozzle of the squirt bottle at the joint to be tested and squeeze the bottle to expose the joint to the test solution vapors. Do not squirt any *liquid* test solution on the process piping as this will produce corrosion damage to the piping.

**CAUTION**

**Header valves and container isolating valves, which  
are simply container valves used as auxiliary shut-off valves,  
should not be opened more than one full turn. Opening beyond  
this point may result in valve damage. One full turn will permit  
maximum flow through these valves. Opening the cylinder valve  
less than one full turn may limit the flow and  
could frost the process piping.**

- c. Turn off the water supply to the ejector and close the chlorinator rate valve, with the cylinder isolation valve or header valve closest to the supply container closed, open the remaining valve on the gas supply piping to the vacuum regulator. These valves must be left open to allow for quick evacuation of the piping system, through the ejector, in the event of a leak.
- d. Turn on the water supply to the ejector and open the isolating valve or header valve (NOT THE CONTAINER VALVE) that was left closed in paragraph c) above.

- e. Open the rate valve on the chlorinator and observe the rotameter. There will be an immediate indication of flow, but it should drop quickly to zero as the air in the piping system is withdrawn. If a major leak exists in the gas supply piping system the flow rate indication will not fall to zero. The source of the major leak must be found by listening to the pipe joints and/or by isolating sections of pipe by closing in-line valves. Repair all leaks and retest as above before any gas is introduced into the system.
- f. When you are satisfied that all the leaks have been fixed, close the chlorinator rate valve and close the isolating valve closest to the gas container. Open and close the gas supply valve, on the container, quickly to charge the system.
- g. Check all the pipe joints between the supply and the closed valve. If a leak is indicated, open the rate valve and the closed valve and evacuate the system through the ejector. Close the rate valve and repair the leak. Leaks around the valve stems may usually be eliminated by tightening the packing nut.
- h. Repeat the test until you are satisfied that there are no leaks and move the testing procedure to the next in-line valve downstream from the gas container. If the gas supply consists of multiple gas cylinder/containers connected to a manifold, test each flexible connector and associated valve individually. Do one valve at a time and recheck all the connections previously checked as gas leaks can be insidious, especially on a new system.
- i. Only one valve should be closed at any time between the gas supply and the gas feeder being used for evacuation. The purpose of this sequence is to pressurize small sections of the gas supply system at one time to enable a person to detect leaks quickly and minimize the potential for multiple leaks occurring during the start-up procedure. This procedure should be followed until the entire gas supply system is pressurized from the container to the vacuum regulator.
- j. When you are satisfied that there are no leaks, a final leak test is advised. Turn on the ejector water supply, pressurize the system and adjust the feed rate control valve to approximately 25% to insure that the gas has filled the entire system. Open all valves one full turn. Turn off the water and then the valve on the gas supply container. Note the pressure on the gas pressure gauge, if present. Leave the system pressurized overnight. Check the vent lines for leaks and investigate the cause after evacuating the system. Upon your return to the system, examine the pressure gauge for pressure loss and again recheck each joint as well as the vent lines for leaks. NOTE: A pressure rise or fall can be caused by a change in the ambient temperature. Consult the temperature pressure curves in Instruction Bulletin 010.3650.
- k. When all the leaks have been repaired and the required vacuum levels have been established, close the cylinder/container valves and proceed to place the system in operation.

### C. Placing in Operation

1. If applicable, plug in the heater(s) and verify that the heater is operating by feeling the top of the manifold drip leg to confirm that it is warm.
- 2a. If the gas dispensing system is of the **single regulator type**, move the "status" lever located on the side of the regulator to its **OPERATING** position.
- 2b. If the gas dispensing system is of the **dual regulator type**, move the "status" lever located on the side of the regulator associated with that portion of the gas supply system that is to be used as the first system in service to its **OPERATING** position. Then move the "status" lever to the second regulator to the **RESERVE** position. This is the stand-by supply.
3. Turn on the water supply to the ejector(s). Open the appropriate cylinder/container, header and cylinder/container isolating valves.

#### CAUTION

**Cylinder/container, header and cylinder/container isolating valves should not be opened more than one full turn. Opening beyond this point may result in valve damage. One full turn will permit maximum flow through the valves. Opening the valves less than one full turn may limit the gas flow and could frost the process piping.**

### WARNING

**Using ton containers as the gas source requires additional care at start-up time, as liquefied gas will be present in the container gas reduction tube. Slowly open the container gas valve and stop when a cavitation noise is heard. This is the liquefied gas vaporizing to its gaseous state due to the pressure drop across the valve. When the noise stops, the container valve should then be opened a total of one full turn. Failing to follow this procedure may allow liquid chlorine to enter the vacuum regulator and meter assembly resulting in possible product damage and bodily injury.**

4. Set the gas feed rate to the point(s) of application by adjusting the rate valve of the associated meter assembly until the float indicates the desired value; eg: that feed rate which is necessary to achieve the desired level of chemical residual in the water or process liquid being treated.

The gas flowrate is read by aligning the center of the indicator ball with the appropriate line on the metering tube.

The time required to achieve the desired level of chemical residual at the sampling point is dependent upon: a) the chemical demand of the overall system, which is greater at time of initial start-up and start-ups following an extended shut-down period; and b) the lag time in the system; i.e., the time required for the chemical solution application to the sampling point. Until these requirements are met, system equilibrium, and hence, chemical residual will not be achieved. The larger the body of water or process liquid being treated, the longer it will take to reach this equilibrium condition.

If the desired level of chemical residual cannot be achieved the first time the Gas Dispensing System is placed in operation, contact the supplier from whom the system was purchased, since this is indicative that the associated components of the system may have been improperly sized.

## 4.2 Operation

### A. General

Initially, and following an extended shutdown period, the gas dispensing system must be started up as described under the initial start-up procedure.

Gas feed rate to the point(s) of application can be changed by simply adjusting the rate valve of the associated meter assembly.

To shut down the system temporarily, shut off the water supply to the ejector(s). It is not necessary to close the cylinder or container valve(s) or any valve(s) in the chemical solution line(s) between the ejector(s) and the point(s) of application. Then, to restart the system, simply turn on the water supply to the ejector(s).

**NOTE:** Should gas continue to flow after the water to the ejector(s) is shut off, it usually indicates that a suction (vacuum) exists at the point of application. There are a couple of exceptions which may cause gas to continue to flow; such as long vacuum lines and/or low gas feed rates. For these exceptions, the gas flow will stop when the vacuum created by the air capacity of the pipeline decreases over a period of time.

In those instances where the exceptions do not apply, it will be necessary to close the valve in the solution line between the ejector and the point of application during this temporary shutdown. When restarting the system, remember to open the valve before turning on the water supply to the ejector.

### WARNING

**During a temporary shutdown period should gas be detected leaking from the vent outlet, this is evidence that the gas inlet valve of the regulator associated with the vent outlet in question has not closed tightly. Should this occur, immediately restart the system. Then, shut down the system as described under Part III, following, and remove and clean the gas inlet valve assembly. Failure to observe this warning may result in bodily injury.**



### CAUTION

1. The rate valve is not designed to serve as a shut-off valve. Attempting to use it in this fashion may result in valve damage.
2. Never open cylinder, container or container type valves more than one full turn as further opening may result in valve damage.

Refer to Instruction Bulletin 010.3650 for information pertaining to care of cylinders or ton containers and maintenance of gas tight seals at all coupling (and flange, if applicable) type connections.

Refer to the troubleshooting chart (troubles “E” through “K”) to become familiar with the “troubles” (as well as their probable causes and corrective actions) which may be encountered during the operation of the gas dispensing system.

### B. Single Regulator Systems Utilizing Cylinder or Ton Container Mounted Vacuum Regulators

The heater, if present, should be checked daily to make certain it is operating by feeling the **top** of the manifold drip leg to confirm that it is warm.

If during the course of normal operation the meter assembly float suddenly begins to bounce up and down rather violently, it usually indicates that the water supply pressure to the ejector is fluctuating over too wide a range. Should this condition occur, check the water supply pressure to the ejector.

If it is determined that this is the cause of the “trouble”, take all necessary steps to eliminate the adverse pressure condition(s). If not, refer to trouble “E” in the troubleshooting chart to determine the other probable causes which may be responsible for the occurrence of float bounce.

When the supply of gas becomes exhausted, as evidenced by observing that the “status” lever of the regulator has moved from its **OPERATING** position to the **EMPTY** position, proceed as directed, to replenish the exhausted supply.

1. Close the cylinder or container valve.
2. Continue to operate the ejector(s) until the meter assembly float falls to zero, indicating that gas flow has stopped. Then, shut off the water supply to the ejector(s).
3. Loosen the yoke screw and disconnect the regulator from the empty cylinder or container.

### CAUTION

**Maintaining ejector operation with the regulator removed from the exhausted cylinder(s) or container(s) will allow moist atmospheric air to be drawn into the gas feed system. This moisture in the presence of chlorine or sulfur dioxide gas will result in the production of acids which will deteriorate the equipment. The resultant deterioration of the equipment and piping system may result in bodily injury.**

Examine and replace the filter if it is dirty or covered with contamination or scale. The cartridge filter (located in the manifold) used with ton-container mounted vacuum regulators should also be replaced when necessary. This can be done by removing the two hex head screws from the top of the manifold and removing the manifold top plate.

If the system includes a pressure gauge, a low or erratic reading could indicate a contaminated cartridge filter.

4. Remove and **discard the lead gasket** from the cylinder or container connection. Connect the regulator to another full cylinder or container as illustrated and described in Figure 4 or 5, as applicable, **using a new lead gasket**.
5. Check the renewed connection for leaks as described under the initial start-up procedure. Then place the system back in operation by moving the “status” lever of the regulator to its **OPERATING** position and turning on the water supply to the ejector(s).



### C. Single Regulator Systems Utilizing Wall Mounted Vacuum Regulators

The heater should be checked daily to make certain it is operating by feeling the **top** of the manifold drip leg to confirm that it is warm.

#### **WARNING**

**Flexible connectors must be arranged in a smooth spiral to prevent kinking. Kinks cause mechanical damage which will result in immediate or eventual rupture. Connectors so damaged through repeated handling must be renewed immediately. Renewal is also required at the first sign of internal or external corrosive attack and steps should be taken to eliminate the condition(s) which have caused this to occur. Failure to observe this warning may result in bodily injury.**

If during the course of normal operation the meter assembly float suddenly begins to bounce up and down rather violently, it usually indicates that either; a) The water supply pressure to the ejector(s) is fluctuating over too wide a range; or b) Liquid chemical is entering the regulator and “flashing off” as it is exposed to the vacuum being created by the ejector. Should this condition occur, first check the water supply pressure to the ejector. If it is determined that this is the cause of the trouble, take all necessary steps to eliminate the adverse pressure condition(s). If not, test the vent outlet for gas flow using a gas mask and test solution that applies to the gas being handled. If gas flow is found, immediately shut down the system as described under Section 5, and check the gas supply system to determine the condition(s) responsible for the formation of liquid chemical. Liquifaction may be caused by pressurized gas lines passing through two or more areas with temperature differentials. Should this be the case, then installation of a pressure reducing valve at the gas source is strongly recommended. Refer to Instruction Bulletin 010.3650 for information concerning this device. If gas flow is not found at the vent outlet, refer to trouble “E” in the troubleshooting chart to determine the other probable causes which may be responsible for the occurrence of float bounce.

When the supply of gas becomes exhausted, as evidenced by observing that the “status” lever of the regulator has moved from its OPERATING position to the EMPTY position, proceed as directed, following, to replenish the exhausted supply.

1. Close the container valve.
2. Continue to operate the ejector(s) until each meter assembly float falls to zero, indicating that gas flow has stopped. Then, proceed to; a) close each container isolating valve, if present, b) close each header valve, if present, and c) shut off the water supply to the ejector(s).

#### **CAUTION**

**Maintaining ejector operation with the flexible connectors removed from the exhausted cylinder(s) will allow moist atmospheric air to be drawn into the gas feed system. This moisture in the presence of chlorine or sulfur dioxide gas will result in the production of acids which will deteriorate the equipment. The resultant deterioration of the equipment and piping system may result in bodily injury.**

3. Disconnect the empty container(s), removing and **discarding the lead gasket(s)**.
4. Connect the full container(s) **using a new lead gasket** in each connection and secure by tightening the coupling nut (or yoke screw) using a wrench.
5. Check each renewed connection for leaks as described under the initial start-up procedure. Then, return the system to operation by moving the “status” lever of the regulator to its OPERATING position and turning on the water supply to the ejector(s).

## D. Dual Regulator Systems Utilizing Cylinder or Ton Container Mounted Vacuum Regulators

The heater, if present, should be checked daily to make certain it is operating by feeling the **top** of the manifold drip leg to confirm that it is warm.

If during the course of normal operation the meter assembly float suddenly begins to bounce up and down rather violently, it usually indicates that the water supply pressure to the ejector is fluctuating over too wide a range. Should this condition occur, first check the water supply pressure to the ejector. If it is determined that this is the cause of the trouble, take all necessary steps to eliminate the adverse pressure condition(s). If not, refer to trouble "E" in the troubleshooting chart to determine the other occurrence of float bounce.

When the supply of gas associated with the regulator in service is exhausted, its status lever moves from OPERATING to EMPTY. Proceed as directed, following, to replenish the exhausted supply.

1. Close the cylinder or container valve associated with the gas supply system of the EMPTY regulator. When the valve is closed, move the "status" lever of this regulator to the RESERVE position.

**NOTE:** If the "status" lever cannot be moved to its RESERVE position, this indicates that the supply of gas for the other regulator has been exhausted. If this is the case, close the cylinder or container valve associated with the gas supply system of the other regulator. Then, shut off the water supply to the ejector(s). Replenish both supplies, and then restart the system in the usual manner.

2. Loosen the yoke screw and disconnect the regulator from the empty cylinder or container.  
Examine and replace the filter pad in the inlet valve assembly if dirty or coated with contamination or scale.
3. Remove and discard the lead gasket from the cylinder or container. The cartridge filter (located in the manifold) used with ton-container mounted vacuum regulators should also be replaced when necessary. This can be done by removing the two hex head screws from the top of the manifold and removing the manifold top plate.

NOTE: The actions performed in Steps 4 and 5, following, are required to prepare the System for checking the renewed connection for leaks as directed in Step 6.

4. Shut off the water supply to the ejector(s).
5. Close the cylinder or container valve of the regulator presently in service. Then move the "status" lever to the regulator just placed on the replacement cylinder or container to its OPERATING position.
6. Check the renewed connection for leaks as described under the initial start-up procedure. Then move the "status" lever of the regulator associated with the replacement cylinder or container to its RESERVE position to place this portion of the gas supply system on "standby".
7. Return the system to operation by moving the "status" lever of the regulator that was previously in service from the empty position to its OPERATING position, if necessary. Then, open the associated cylinder or container valve one full turn and turn on the water supply to the ejector(s).

## E. Dual Regulator Systems Utilizing Wall Mounted Vacuum Regulators

The heater should be checked daily to make certain it is operating by feeling the top of the manifold to confirm that it is warm.

### WARNING

**Flexible connectors must be arranged in a smooth spiral to prevent kinking. Kinks cause mechanical damage which will result in immediate or eventual rupture. Connectors so damaged through repeated handling must be renewed immediately. Renewal is also required at the first sign of internal or external corrosive attack and steps should be taken to eliminate the condition(s) which have caused this to occur. Failure to observe this warning may result in bodily injury.**

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If during the course of normal operation the meter assembly float suddenly begins to bounce up and down rather violently, it usually indicates that either; a) the water supply pressure to the ejector is fluctuating over too wide a range; or b) liquid chemical is entering the "in service" regulator and "flashing off" as it is exposed to the vacuum being created by the ejector.

Should this condition occur, first check the water supply pressure to the ejector. If it is determined that this is the cause of the "trouble", take all necessary steps to eliminate the adverse pressure condition(s). If not, refer to trouble "E" in the troubleshooting chart to determine the other occurrence of float bounce.

When the supply of gas associated with the OPERATING regulator for gas flow using a gas mask and test solution that applies to the gas being handled. If gas flow is found, immediately shut down the System as described under Section 5, and check the gas supply system associated with the regulator that was previously in service, now indicating EMPTY, to determine the condition(s) responsible for the formation of liquid chemical. Liquefaction may be caused by pressurized gas lines passing through two or more areas with temperature differentials. Should this be the case then installation of a pressure reducing valve at the gas source is strongly recommended. Refer to Instruction Bulletin 010.3650 for information concerning this device. If gas flow is not found at the vent outlet, refer to Trouble "E" in the Troubleshooting Chart to determine the other probably causes which may be responsible for the occurrence of float bounce.

When the supply of gas associated with the regulator in service is exhausted, its status lever will move from OPERATING to EMPTY. Proceed as directed, to replenish this exhausted supply.

1. Close each container valve associated with the gas supply system of the EMPTY regulator. When the valve is closed, move the "status" lever of this regulator to the RESERVE position.

**WARNING**

**If the "status" lever cannot be moved to its reserve position, this indicates that the supply of gas for the other regulator has been exhausted. If this is the case, close the cylinder or container valve associated with the gas supply system of the other regulator. Then, shut off the water supply to the ejector(s). Replenish both supplies, and then restart the system in the usual manner.**

2. Disconnect the empty container(s), removing and **discarding the lead gasket(s)**.
3. Connect the full container(s) using a new lead gasket in each connection and secure by tightening the coupling nut (or yoke screw) using a wrench.

**NOTE:** The actions performed in steps 4 and 5, following, are required to prepare the System for checking the renewed connection for leaks as directed in step 6.

4. Shut off the water supply to the ejector(s).
5. Close each container valve associated with the regulator presently in the OPERATING mode. Then move the "status" lever to the regulator associated with the renewed or reserve container(s) to the OPERATING position.
6. Check each renewed connection for leaks as described under the initial start-up procedure. Then move the "status" lever of the regulator associated with the renewed container(s) to its RESERVE position to place this portion of the gas supply system on "standby".
7. Return the system to operation by moving the "status" lever of the regulator that was previously in service from the EMPTY position to its OPERATING position, if necessary. Then, open the associated container(s) valve one full turn and turn on the water supply to the ejector(s).

## 5 SHUTDOWN

### WARNING

**Before disconnecting or disassembling the ejector, shutdown the system as described in Section 5.1. Failure to do so may result in serious injury or death.**

### 5.1 Shutdown For Servicing

1. Close the gas supply valve at the pressure source(s) to shut off the gas flow. This is normally the gas cylinder and/or container valve(s) supplying the gas dispensing (regulator) system. The rate valve on the dispensing system meter panel(s) is/are not to be used to shut off the gas flow. The float in the gas flow meter(s) should drop to the bottom of the flow meter indicating zero (no gas feed)
2. Continue the flow of water through the ejector for a few minutes to remove all gas remaining in the feeder, pressure piping and vacuum tubing. While the ejector continues to operate remove the Vacuum Regulator(s) from the closed off gas source to allow air to enter the unit further diluting the residual gas. Stop the ejector water flow and relieve all residual water pressure. Close any water supply and chemical solution valves to isolate the ejector.
3. Before starting up the System after servicing, refer to the initial start-up procedure in the equipment instruction manual and perform any or all steps deemed necessary as related to the extent of servicing performed.

### 5.2 Shutdown for Extended Period

1. Close the gas supply valve at the pressure source(s) to shut off the gas flow. This is normally the gas cylinder and/or container valve(s) supplying the gas dispensing (regulator) system. The rate valve on the dispensing system meter panel(s) is/are not to be used to shut off the gas flow. The float in the gas flow meter(s) should drop to the bottom of the flow meter indicating zero (no gas feed)
2. Continue the flow of water through the ejector for a few minutes to remove all gas remaining in the feeder, pressure piping and vacuum tubing. While the ejector continues to operate remove the Vacuum Regulator(s) from the closed off gas source to allow air to enter the unit further diluting the residual gas. Stop the ejector water flow and relieve all residual water pressure. Close any water supply and chemical solution valves to isolate the ejector.
3. If applicable, unplug the heater(s).

Ideally, the gas supply system(s) should remain intact to prevent moisture from coming into contact with and corroding the surfaces normally exposed to the gas. If this is not possible, plug all open connections with a rubber or plastic stopper to protect against corrosion during the extended shut-down period.

If the installation is to be subjected to temperatures below freezing during the extended shutdown period, disconnect and drain all lines and components in the water supply and chemical solution distribution systems which will be exposed to freezing conditions.

## 6 SERVICING

### WARNING

**Before disconnecting or disassembling any component, shut down the gas dispensing system as described in Part III under operating instructions. Failure to observe this warning may result in operator bodily injury.**

### 6.1 General

It is recommended that the Gas Dispensing System be inspected and serviced a minimum of once per year. More frequent service periods may be required due to: 1) the type, quality and quantity of the gas being handled, 2) the complexity of the gas supply system, 3) the quality and quantity of water or process liquid being used to operate the ejector(s), and 4) operation procedures.

More frequent service periods are especially indicated when venting of the VR is occurring during the one year operational period. This is usually indicative of foreign debris holding the inlet valve open or destruction of the inlet valve parts caused by the gas quality not up to industry purity standards.

Preventative maintenance kits for each of the assemblies are available from the factory. Each kit contains all the parts and detailed instructions that are required for complete maintenance. All resilient parts (O-ring, gaskets) that have been disturbed during the disassembly must be replaced during reassembly in order to insure safe, trouble free operation. Failure to replace these parts may result in bodily injury.

The maintenance kits for  $CL_2$  and  $SO_2$  are as follows:

Vacuum Regulator	614S090U01
Inlet Valve	668B130U01
Cylinder Mounted Vacuum Regulator	10 filters and 10 lead gaskets
	614S091U01
Ejector	614S092U01 (EJ17), 14436, 14432 & 14433 Series (All Others)
Gas Manifold, 2 filters and 6 lead washers	614S095U01
Meter Assembly	614S096U01
25 Lead gaskets	BM-4901

The nature and extent of servicing is dependent upon: 1) the complexity of the gas supply system 2) the type, quality, and quantity of gas being handled, and 3) the quality and quantity of water or process liquid being used to operate the ejector(s). Therefore, servicing requirements for each gas dispensing system will be learned from experience. For Ammonia Service, refer to the parts list 100.7601 for recommended spare parts to be used for the periodic service.

The manner in which the components can be disassembled for servicing (and reassembled after servicing) becomes apparent by simply referring to their illustrated "exploded views" in the parts list furnished with these instructions or the instructions provided with the maintenance kits.

The optional gas pressure gauge (furnished with wall and ton container mounted regulators, requires no routine maintenance and should never be disassembled. Tampering with the seal results in loss of fill fluid and failure of the gauge.

### CAUTION

**During disassembly and cleaning of any component, inspect all parts thoroughly and replace any worn or damaged part immediately. When a part needs replacing, it is mandatory that the new part needs to be made of materials that will withstand the corrosive action of the gas being handled. Failure to use proper replacement parts as supplied by Severn Trent Services can result in bodily injury.**

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Only Severn Trent Services replacement parts, manufactured from materials selected for their proper corrosion-resistance properties, must be used. Factory approved parts are available from the supplier. When ordering parts, always note the complete model and serial number of the gas dispensing system as well as the gas service in which it is being used. If desired, the equipment in need of repair may be returned to Severn Trent Services , 3000 Advance Lane, Colmar, PA 18915 for servicing or complete overhaul.

## **6.2 Cleaning Agents**

The preferred cleaning agent is a mild soap solution. Mineral deposits can be removed with dilute hydrochloric (muriatic) acid. The parts being cleaned should be soaked in the acid, being careful to prevent the acid from coming in contact with the skin or clothing.

After cleaning with any of the above agents, rinse with clean water (to remove all traces of the cleaning agent) and dry thoroughly (to remove all traces of water) before returning to service.

## **6.3 Lubricating Agents**

The recommended lubricating agents are a graphite-petroleum mixture, included in the maintenance kits, or fluorolube. The use of lubricants is discussed in the maintenance kit instructions. Their use is only to allow the parts to be assembled with more ease. They are not to be used as a vacuum sealing grease and must be used very sparingly.

## **6.4 O-Rings**

To seal perfectly, o-rings must be properly seated and be soft and pliable. Any o-ring disturbed or moved must be replaced to insure the integrity of the seal. The preventative maintenance kits contain all the required o-rings.

## **6.5 Diaphragms**

Diaphragms should be inspected each time a component with diaphragms is disassembled for servicing. When disassembling the vacuum regulator, be sure to observe the orientation of the convolutions (ridges) on the diaphragms so that they may be reinstalled in the same position. Replace any diaphragm that shows signs of cracks or weak spots. A crack or potential crack line will appear as a milky white line. Upon reassembly, lubricant should be applied to the surfaces of the diaphragm which come in contact with the clamping surfaces of their backing plates or bolts. Lubricant should always be applied sparingly. If the diaphragm has convolutions, be certain to properly orient the diaphragm.

## **6.6 Check Valves**

The sealing surfaces of check valves, eg: the ball and o-ring seat in ball types and the plug and seat in diaphragm types, must be clean and smooth to provide a perfect seal. **Use no lubricants on sealing surfaces.**

## **6.7 Hose Lines**

Periodically inspect all hose lines for cracks or weak spots which may develop with aging. Faulty lines should be replaced. Hose should be protected from strain, freezing, or mechanical damage.

## **6.8 Tubing Replacement**

Replacement of all vacuum tubing when it shows signs of wear (cracking, etc) is recommended. In high humidity situations, external blistering may occur. This does not effect the performance of the tubing.

## **6.9 Inlet Valve**

The inlet fitter should be examined whenever a regulator is removed from the cylinder. If it is dirty, plugged, or excessively contaminated, it should be replaced. Regulators that handle high gas flow-rates will probably need filter replacement more often than others. The cleanliness of the supply gas from cylinders and ton containers will also be a factor contributing to this problem. For the inlet valve maintenance use preventative maintenance kit P/N 668B130U01.

## **6.10 Manifold**

The gas manifold heater may be replaced by removing the self clamping heater from the drip leg. Replace filter and gaskets with preventative maintenance kit P/N 614S095U01.

## 7 TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
1. Flowmeter fails to indicate required air flow rate when operating vacuum is being checked the first time that the Gas Dispensing System is placed in operation.	<ul style="list-style-type: none"> <li>a. Length of vacuum line(s) exceeds(s) maximum allowable transport distance.</li> <li>b. Vacuum line(s) crimped.</li> <li>c. Leakage at pipe-to-tube vacuum line connection at outlet from flowmeter-rate valve assembly and/or inlet to ejector.</li> <li>d. Ejector throat is not full of water. (Applies only when the ejector is wall mounted in a horizontal position and back pressure is zero or less at the point of application.</li> <li>e. Insufficient ejector vacuum resulting from insufficient water supply pressure for existing back pressure conditions.</li> </ul>	<ul style="list-style-type: none"> <li>a. Refer to Appendix.</li> <li>b. Arrange line(s) to eliminate crimping.</li> <li>c. Tighten/inspect/re-make each connection, as required.</li> <li>d. Refer to Instruction Bulletin 010.3650.</li> <li>e. After first re-checking start-up procedure and above listed probably causes to definitely confirm that this is the cause of trouble, contact the supplier from whom the Gas Dispensing System was purchased.</li> </ul>
2. Flowmeter fails to indicate required air flow rate when operating vacuum is being checked following an extended out of service period or servicing shutown.	<ul style="list-style-type: none"> <li>a. Vacuum line(s) crimped.</li> <li>b. Leakage at pipe-to-tube vacuum line connection at outlet from flowmeter-rate valve assembly and/or inlet to ejector.</li> <li>c. Leakage around stem seal-ring of rate valve assembly.</li> <li>d. Leakage around seals (O-ring or gasket type, depending on capacity) of flowmeter outlet adaptor fitting.</li> <li>e. Insufficient ejector vacuum.</li> </ul>	<ul style="list-style-type: none"> <li>a. Arrange line(s) to eliminate crimping.</li> <li>b. Tighten/inspect/re-make each connection, as required.</li> <li>c. Inspect and renew rate valve assembly, if necessary.</li> <li>d. Inspect and reseal or renew seals, as required.</li> <li>e. Refer to Trouble 11.</li> </ul>
3. Flowmeter continues to indicate air flow and/or "status" lever of regulator fails to move to its EMPTY position when the System is dead-ended when operating vacuum is being checked the first time that the Gas Dispensing System is placed in operation.	<ul style="list-style-type: none"> <li>a. Leakage around seal plug O-ring in auxiliary connection of flowmeter-rate valve assembly.</li> <li>b. Leakage at pipe-to-tube or O-ring seal connection(s), as applicable, in vacuum portion of Gas Dispensing System on upstream side of flowmeter-rate valve(s).</li> <li>c. Regulator diaphragm cracked, ruptured or exhibiting leakage around its sealing surfaces.</li> </ul>	<ul style="list-style-type: none"> <li>a. Tighten seal plug; or, inspect and reseal or renew O-ring as required.</li> <li>b. Tighten/inspect/re-make each pipe-to-tube connection; or, inspect and reseal or renew each O-ring seal connection, as required and applicable.</li> <li>c. After first re-checking the above listed probably causes to definitely confirm that this is the cause of the trouble, contact the supplier from whom the Gas Dispensing System was purchased.</li> </ul>



TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
4. Flowmeter continues to indicate air flow and/or "status" lever of regulator fails to move to its EMPTY position when the system is dead-ended when operating vacuum is being checked following an extended out-of-service period or servicing shutdown.	a. Leakage around seal plug O-ring in auxiliary connection of flowmeter-rate valve assembly. b. Leakage at pipe-to-tube or O-ring seal connection(s), as applicable, in vacuum portion of Gas Dispensing System on upstream side of flowmeter-rate valve(s). c. Leakage around seals (O-ring or gasket type, depending on capacity) of flowmeter inlet adaptor fitting. d. Regulator diaphragm cracked, ruptured or exhibiting leaked around its sealing surfaces.	a. Tighten seal plug; or inspect and reseal or renew O-ring, as required. b. Tighten/inspect/re-make each pipe-to-tube connection; or, inspect and reseal or renew each O-ring seal connection as required and applicable. c. Inspect and reseal or renew seals, as required. d. Disassemble regulator and take all necessary steps to correct this condition.
5. Flowmeter float observed to be bouncing up and down and/or maximum gas flow rate cannot be achieved during the course of normal operation.	a. Gas inlet valve of regulator dirty. b. Rate valve dirty. c. Flowmeter dirty. d. Filter in flowmeter inlet dirty. (Applies only to low capacity flowmeters.) e. Filter in regulator inlet dirty. f. Filter in manifold inlet dirty. (Applies only to wall or ton container mounted regulators.) g. Leakage at some point in vacuum portion of Gas Dispensing System. h. Insufficient ejector vacuum. (Applies only to inability to achieve maximum gas flow rate.)	a. Clean gas inlet valve. b. Clean rate valve. c. Clean flowmeter. d. Renew filter. e. Clean filter. f. Renew filter. g. Refer to probable causes and corrective actions listed under Trouble 2 and 4. h. Refer to Trouble 11.
6. Maximum gas flow fails to provide desired level of chemical residual at point of application.	a. Leakage at some point in vacuum portion of Gas Dispensing System on upstream side of flowmeter. b. Chemical demand of water or process liquid has increased above original designed capacity.	a. Refer to probable causes and corrective actions listed under Trouble "4" b. Contact the supplier from whom the Gas Dispensing System was purchased for possible size increase to a larger capacity.
7. Minimum gas flow provides too high a level of chemical residual at point of application.	Chemical demand of water or process liquid has decreased below original designed capacity.	Contact the supplier from whom the Gas Dispensing System was purchased for possible size decrease to a smaller capacity.
8. Flowmeter fails to indicate gas flow during the course of normal operation but "status" lever of regulator remains in its OPERATING position.	a. Vacuum line(s) crimped. b. Rate valve inadvertently closed. c. Rate valve plugged. d. Flowmeter plugged. e. Filter in flowmeter inlet plugged. (Applies only to low capacity flowmeters.) f. Loss of vacuum condition on downstream side of flowmeter.	a. Arrange line(s) to eliminate crimping. b. Open rate valve. c. Clean rate valve. d. Clean flowmeter. e. Renew filter. f. Refer to probable causes and corrective actions listed under Trouble 2.



TROUBLE	PROBABLY CAUSE	CORRECTIVE ACTION
9. "Status" lever of regulator moves to its EMPTY position during the course of normal operation	a. Gas supply valve(s) inadvertently closed. b. Gas supply exhausted. c. Filter in regulator inlet plugged. d. Gas inlet valve of the regulator stuck in the closed position. e. Filter in manifold inlet plugged. (Applies only to wall or ton container mounted regulators.)	a. Open all supply valve(s) to a total of one full turn. b. Replenish supply. c. Renew filter. d. Clean gas inlet valve. e. Renew filter.
10. Water noted in flowmeter or discharging from ejector drain outlet, as applicable, at time of shutdown.	a. Ejector back-flow check valve(s) faulty.	a. Inspect, clean and/or repair back-flow check valve(s).
11. Insufficient ejector vacuum.	a. Y-strainer in water supply line is dirty, thereby reducing the available supply pressure. b. Ejector drain valve not sealing. (EJ17 Ejector) c. Back pressure is greater than the value listed on the tag attached to the ejector, for one of the following reasons: 1. solution valve(s), if present, not fully open. 2. solution line, if present, is partially blocked. 3. back pressure at point of application has increased above its original value. d. Ejector nozzle and/or throat dirty. e. Ejector throat is not full of water. (Applies only when the ejector is wall mounted in a horizontal position and back pressure is zero or less at point of application. f. Ejector nozzle and throat are worn.	a. Clean Y-strainer; and, if this does not correct the trouble, refer to Troubleshooting Procedure 1 in the Troubleshooting Section of Instruction Bulletin 122.6060. b. Refer to Troubleshooting Procedure 2 in the Instruction Bulletin 122.6060. c. Open solution valve(s); clean solution line; determine cause of abnormally high back pressure and take all necessary steps to correct this condition. d. Clean nozzle and/or throat. e. Refer to Instruction Bulletin 010.3650. f. Replace with a new nozzle and throat.
12. Gas leaking from vent line.	a. Inlet valve stem length at incorrect length. b. Inlet valve seat has dirt accumulation preventing proper operation. c. Scored valve seat.	a. Adjust stem length to 2.198" as indicated in the parts list. b. Clean gas inlet valve. c. Replace valve seat and plug.

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# APPENDIX

## VACUUM LINE(S) – LIMITS OF EXTENSION

The vacuum line(s) connecting the regulator(s) to the ejector(s), either directly or indirectly, via one or more wall mounted meter assembly, must not exceed the distance(s) presented in Figures 14 through 16 and the use of the factors provided in Table B, if applicable.

**NOTE:** The graphs in Figures 14 through 16 are for gas dispensing systems in which the interconnecting vacuum line(s) are the normally specified 5/8 inch (5/8" OD x 1/2" ID) flexible tubing. If the required gas flow rate(s) exceed the maximum allowable limits as determined by the graphs (and factors, if applicable), 3/4 inch (or larger) schedule 80 PVC piping must be used in the construction of all (or portions of) the vacuum line(s). In such instances, it will be necessary to contact the supplier from whom the gas dispensing system was purchased for technical assistance.

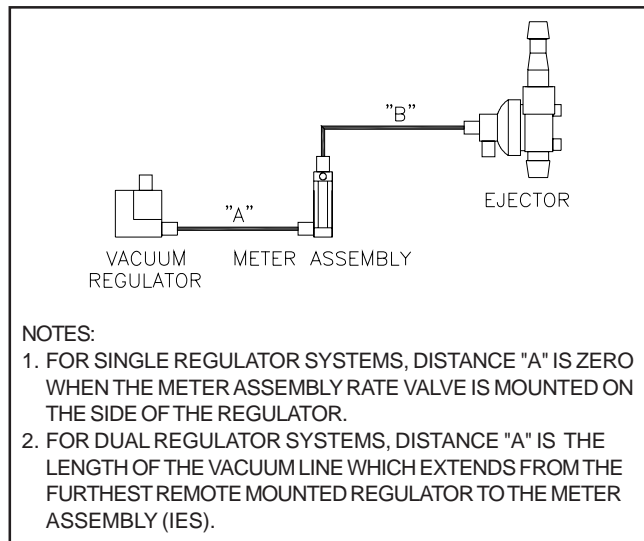


Figure 13 - Pictorial Representation of the Reference Distances Plotted in Figure 14 through 16.

The following examples demonstrate the use of the graphs (and factors) for determining the use of the graphs (and factors) for determining the maximum allowable transport distance(s) for chlorine gas dispensing systems. Determinations establishing the maximum allowable transport distance(s) for sulfur dioxide and ammonia gas dispensing systems are made in an identical manner by simply referencing Figures 15 and 16 respectively. The factors provided in Table B, which constitute interrelated split flow proportionality factors, are independent of the particular gas in question. Therefore, they apply "across-the-board" for determining the "B" distances for either chlorine, sulfur dioxide, or ammonia split flow type gas dispensing systems.

### Example A

System: Single regulator type with integrally mounted meter-rate valve assembly having a maximum capacity of 100 lb/d (2 kg/h).

Determination: (Refer to Figures 13 and 14.) Since distance "A" is zero, the vacuum line between the meter-rate valve assembly and ejector (distance "B") can be extended to any distance up to 720 feet.

### Example B

System: Single or dual regulator type with one wall mounted meter-rate valve assembly having a maximum capacity of 300 lb/d (6 kg/h).

Determination: (Refer to Figures 13 and 14.) The vacuum lines between the single or furthest remote mounted regulator, as applicable, and the meter-rate valve assembly (distance "A") and the meter-rate valve assembly and ejector (distance B) can be extended up to any combination of interrelated distances as ascertained from the graph, eg: 20 feet and 96 feet, 80 feet and 58 feet, 120 feet and 34 feet, etc., respectively.

MAXIMUM SYSTEM CAPACITY lb/d (kg/h)	CAPACITY OF INDIVIDUAL FLOWMETER-RATE VALVE ASSEMBLIES lb/d (kg/h)					
	50 (1)	100 (2)	200 (4)	250 (5)	300 (6)	500 (10)
50 (1)	1.00					
100 (2)	3.34	1.00				
200 (4)	11.08	3.31	1.00			
250 (5)	16.35	4.89	1.48	1.00		
300 (6)	22.26	6.66	2.01	1.36	1.00	
500 (10)	54.64	16.34	4.93	3.34	2.45	1.00

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### Example C

System: Single or dual regulator type with three wall mounted meter-rate valve assemblies; one having a maximum capacity of 300 lb/d (6 kg/h) and two having a maximum capacity of 100 lb/d (2 kg/h).

Determination: (Refer to Figures 13 and 14 and Table B.) The vacuum lines between the single or furthest remote mounted regulator, as applicable, and the meter-rate valve assemblies and ejectors (distance “B”) can be extended up to any combination of interrelated distances as ascertained from the 500 lb/d (10 kg/h) graph. (This graph is used since the total gas flow in the vacuum line(s) between the regulator(s) and the meter-rate valve assemblies is 500 lb/d.) However, in this instance, the “B” distances are not limited to the value obtained directly from the graph since they are further related to the gas flow from each of the meter-rate valve assemblies to their companion ejectors. Therefore, each “B” distance is determined by multiplying the value obtained from the graph by the appropriate factor provided in Table B. For example, if distance “A” is 20 feet: the vacuum line from the 300 lb/d assembly can be extended to any distance up to  $32 \times 2.45$  or 78.4 feet; and, the vacuum line from each 100 lb/d assembly can be extended to any distance up to  $32 \times 16.34$  or 522.9 feet.

**NOTE:** In those instances where the total gas flow is higher or lower than the values for which exacting split flow values can be calculated from the data provided herein, it will be necessary to; a) calculate the split flow values by conservative interpolation of this data, or b) contact the supplier from whom the gas dispensing system was purchased for technical assistance.

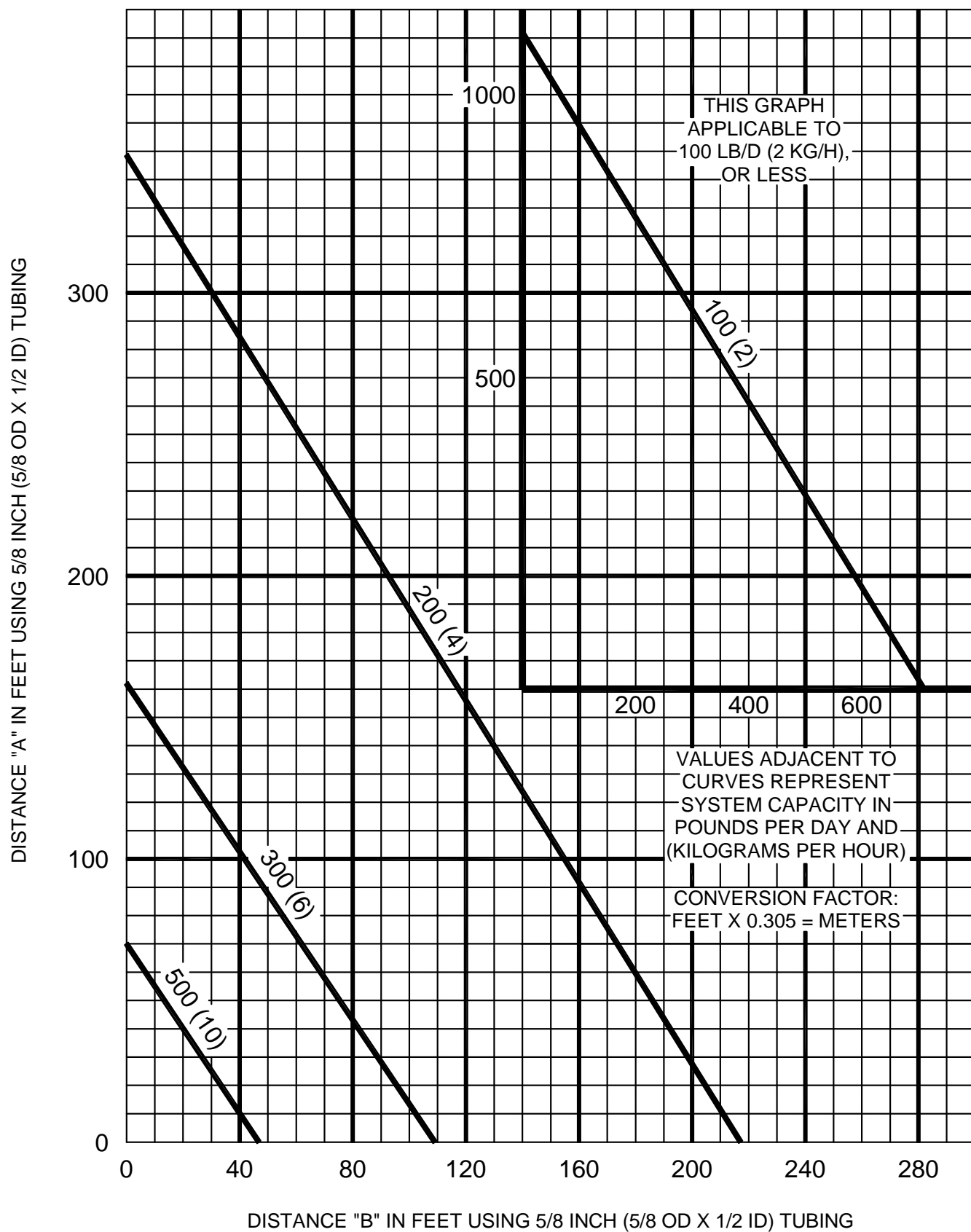


Figure 14 - Vacuum Line(s) Limits of Extension vs. Maximum System Capacity for Chlorine Gas Dispensing System

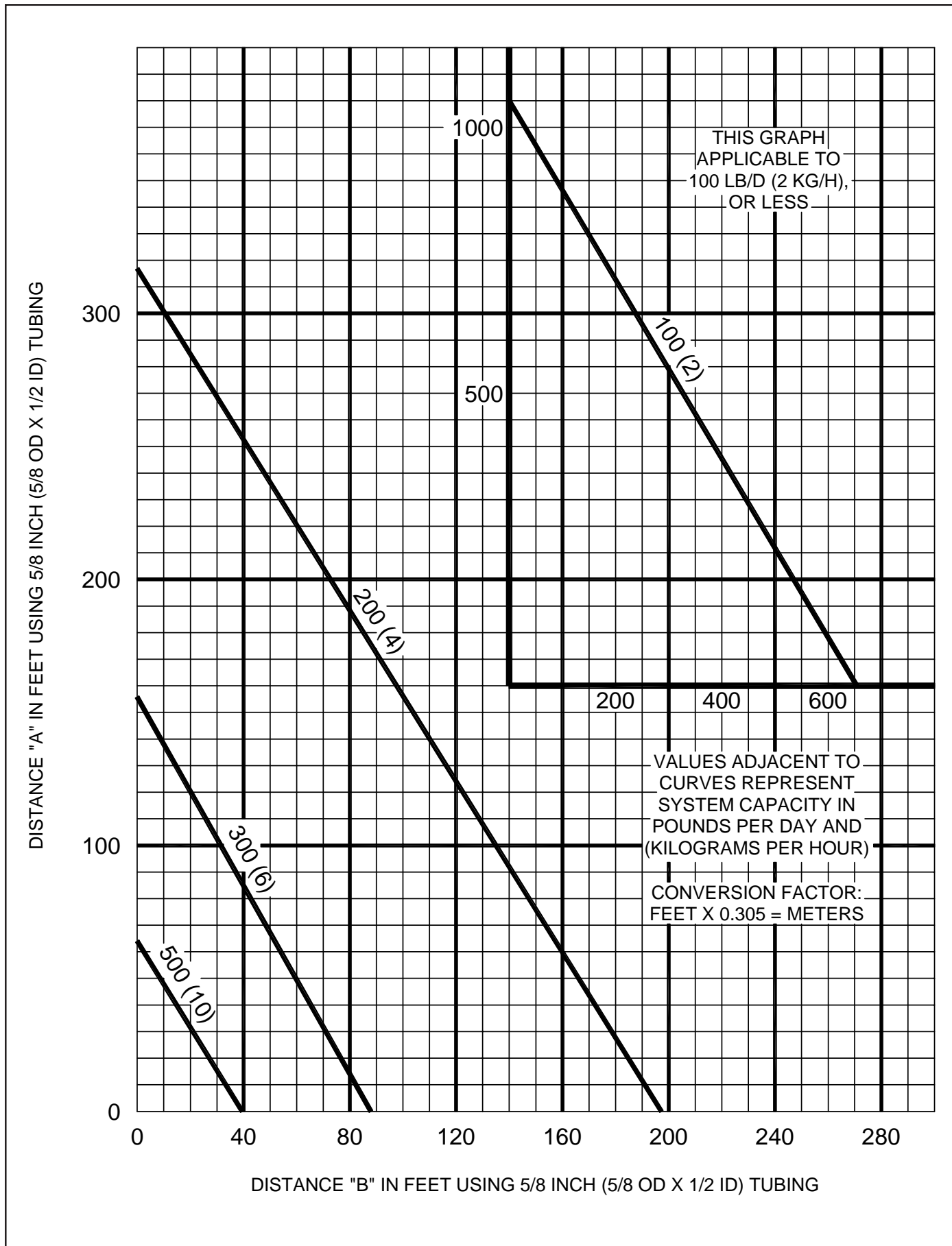


Figure 15 - Vacuum Line(s) Limits of Extension vs. Maximum System Capacity for Sulfur Dioxide Gas Dispensing System

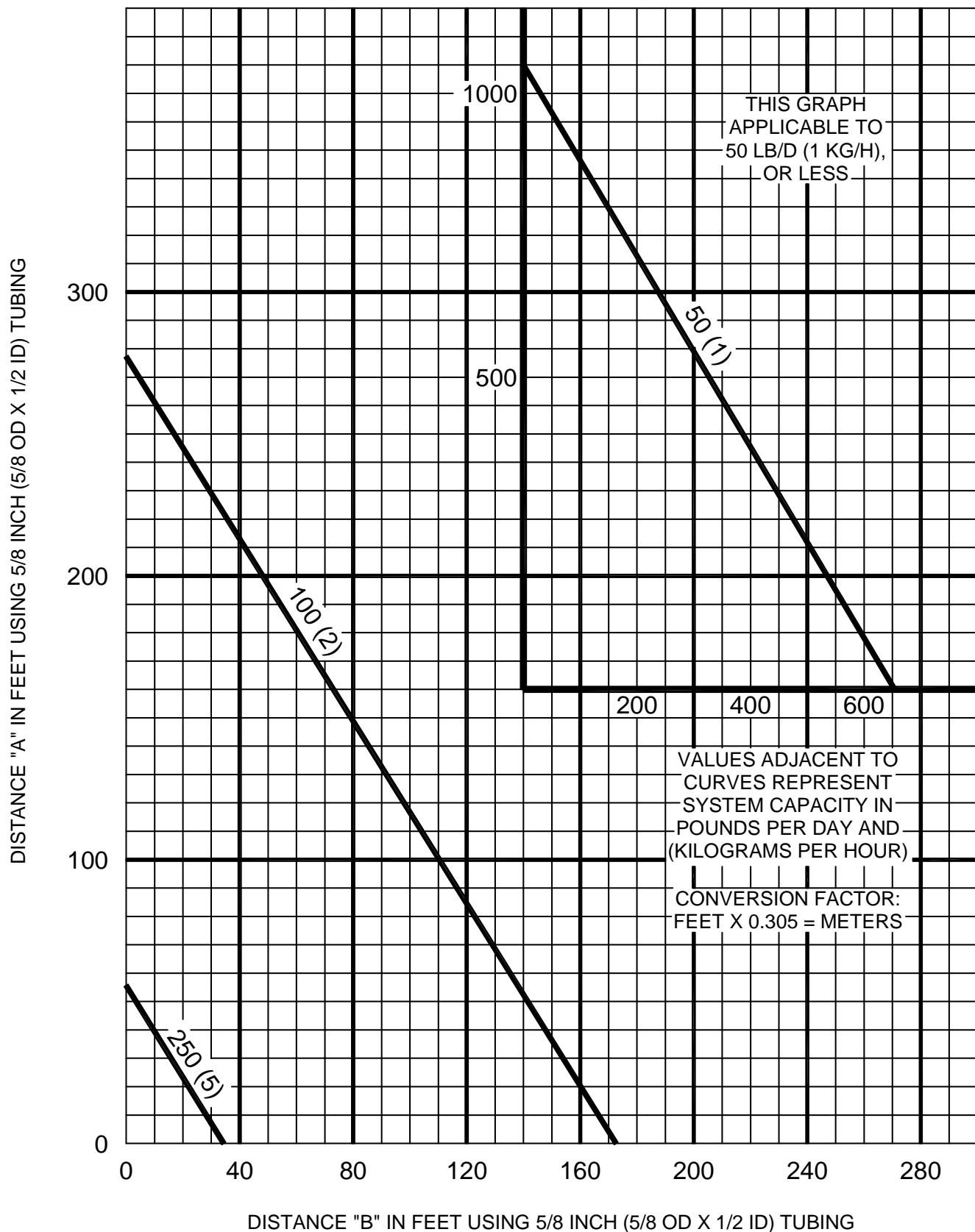


Figure 16 - Vacuum Line(s) Limits of Extension vs. Maximum System Capacity for Ammonia Gas Dispensing System

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Design improvements may be made without notice.

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