

Wallace & Tiernan[®]

an eVOQUA brand

Gas Pressure Reducing Valve Series 50-185 (Manual)

BOOK NO. WT.050.185.001.UA.IM.0814

W3T110623

**GAS PRESSURE
REDUCING VALVE
SERIES 50-185 (MANUAL)**

BOOK NO. WT.050.185.001.UA.IM.0814

GAS PRESSURE REDUCING VALVE

EQUIPMENT SERIAL NO. _____

DATE OF START-UP _____

START-UP BY _____

Prompt service available from nationwide authorized service contractors.

ORDERING INFORMATION

In order for us to fill your order immediately and correctly, please order material by description and part number, as shown in this book. Also, please specify the serial number of the equipment on which the parts will be installed.

WARRANTY

Seller warrants for a period of one year after shipment that the equipment or material of its manufacture is free from defects in workmanship and materials. Corrosion or other decomposition by chemical action is specifically excluded as a defect covered hereunder, except this exclusion shall not apply to chlorination equipment. Seller does not warrant (a) damage caused by use of the items for purposes other than those for which they were designed, (b) damage caused by unauthorized attachments or modifications, (c) products subject to any abuse, misuse, negligence or accident, (d) products where parts not made, supplied, or approved by Seller are used and in the sole judgment of the Seller such use affects the products' performance, stability or reliability, and (e) products that have been altered or repaired in a manner in which, in the sole judgment of Seller, affects the products' performance, stability or reliability. **SELLER MAKES NO OTHER WARRANTY OF ANY KIND, AND THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS OF THE MATERIAL OR EQUIPMENT FOR ANY PARTICULAR PURPOSE EVEN IF THAT PURPOSE IS KNOWN TO SELLER.** If Buyer discovers a defect in material or workmanship, it must promptly notify Seller in writing; Seller reserves the right to require the return of such defective parts to Seller, transportation charges prepaid, to verify such defect before this warranty is applicable. In no event shall such notification be received by Seller later than 13 months after the date of shipment. No action for breach of warranty shall be brought more than 15 months after the date of shipment of the equipment or material.

LIMITATION OF BUYER'S REMEDIES. The **EXCLUSIVE REMEDY** for any breach of warranty is the replacement f.o.b. shipping point of the defective part or parts of the material or equipment. Any equipment or material repaired or replaced under warranty shall carry the balance of the original warranty period, or a minimum of three months. Seller shall not be liable for any liquidated, special, incidental or consequential damages, including without limitation, loss of profits, loss of savings or revenue, loss of use of the material or equipment or any associated material or equipment, the cost of substitute material or equipment, claims of third parties, damage to property, or goodwill, whether based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory; provided, however, that such limitation shall not apply to claims for personal injury.

Statements and instructions set forth herein are based upon the best information and practices known to Evoqua Water Technologies, but it should not be assumed that every acceptable safety procedure is contained herein. Of necessity this company cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.



725 Wooten Road
Colorado Springs, Co 80915

GAS PRESSURE REDUCING VALVE

INTRODUCTION

The Series 50-185 Gas Pressure Reducing Valve described in this instruction book may be used without modification to handle chlorine or sulfur dioxide.

The primary purpose of a gas pressure reducing valve is to minimize the possibility of reliquefaction of gas in a supply line. In addition, when used in conjunction with equipment whose performance may be affected by variations in gas supply pressure, a gas pressure reducing valve will provide more satisfactory operation.



WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT, THIS EQUIPMENT SHOULD BE INSTALLED, OPERATED, AND SERVICED ONLY BY TRAINED, QUALIFIED PERSONNEL WHO ARE THOROUGHLY FAMILIAR WITH THE ENTIRE CONTENTS OF THIS INSTRUCTION BOOK.

NOTE: When ordering material, always specify model and serial number of apparatus.

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GAS PRESSURE REDUCING VALVE

VERY IMPORTANT SAFETY PRECAUTIONS - CHLORINE

This page provides very important safety information related to safety in installation, operation, and maintenance of this equipment.

WARNING

TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, OBSERVE THE FOLLOWING:

THIS EQUIPMENT SHOULD BE INSTALLED, OPERATED, AND SERVICE ONLY BY TRAINED, QUALIFIED PERSONNEL WHO ARE THOROUGHLY FAMILIAR WITH THE ENTIRE CONTENTS OF THIS INSTRUCTION BOOK AND THE CHLORINE GAS HANDLING MANUAL.

CHLORINE GAS IS A RESPIRATORY IRRITANT. EXPOSURE TO CHLORINE GAS IN SUFFICIENT CONCENTRATION PRODUCES IRRITATION OF THE MUCOUS MEMBRANES, THE RESPIRATORY SYSTEM, AND THE SKIN. IN EXTREME CASES, SUFFOCATION AND DEATH CAN OCCUR.

WHEN CHANGING CHLORINE CYLINDERS, IT IS RECOMMENDED PRACTICE TO HAVE AN APPROVED GAS MASK AVAILABLE THAT YOU HAVE BEEN TRAINED TO USE AND YOU MUST BE COMPLETELY FAMILIAR WITH YOUR LOCAL PLANT OPERATING AND EMERGENCY PROCEDURES AND CHLORINE INSTITUTE RECOMMENDED EMERGENCY PROCEDURES.

DO NOT TOLERATE ANY CHLORINE LEAKS. CHLORINE LEAKS NEVER GET BETTER. CHLORINE LEAKS ALWAYS GET PROGRESSIVELY WORSE IF THEY ARE NOT PROMPTLY CORRECTED. IT IS RECOMMENDED PRACTICE TO HAVE AN APPROVED GAS MASK AVAILABLE WHEN MAKING LEAK CHECKS.

AS SOON AS THERE IS ANY INDICATION OF CHLORINE IN THE AIR, TAKE IMMEDIATE STEPS TO CORRECT THE CONDITION.

IMPORTANT INFORMATION RELATED TO SAFETY OF CHLORINATION EQUIPMENT INSTALLATION IS PROVIDED IN THE CHLORINE GAS HANDLING MANUAL. IN THE INTEREST OF SAFE OPERATION, THIS INFORMATION MUST BE READ, UNDERSTOOD, AND PRACTICED BY EQUIPMENT OPERATORS AND THEIR SUPERVISORS.

AT TIME OF INITIAL INSTALLATION, WHEN CHLORINE SUPPLY LINES HAVE BEEN DISCONNECTED FOR ANY REASON AND ON A ROUTINE DAILY BASIS, THOROUGHLY CHECK ALL JOINTS, CONNECTIONS, AND EQUIPMENT FOR POSSIBLE CHLORINE LEAKS AND IMMEDIATELY CORRECT ANY THAT MAY BE FOUND.

WHEN ANY CONNECTION IS BROKEN EVEN FOR A SHORT TIME, IMMEDIATELY PLUG THE RESULTANT OPENINGS WITH A RUBBER STOPPER OR EQUIVALENT TO PREVENT THE ENTRANCE OF MOISTURE. MOISTURE MUST BE EXCLUDED FROM ANY PART OF THE EQUIPMENT THAT IS NORMALLY EXPOSED TO DRY CHLORINE ONLY. WHILE DRY CHLORINE IS NON-CORROSIVE, MOIST CHLORINE IS EXTREMELY CORROSIVE TO COMMON METALS, SUCH AS BRASS OR STEEL.

GAS PRESSURE REDUCING VALVE

VERY IMPORTANT SAFETY PRECAUTIONS - CHLORINE (CONT'D)

THE TWO MOST COMMON CAUSES OF CHLORINE PIPING LEAKS ARE:

1. RE-USE OF GASKETS. THIS SHOULD NEVER BE DONE. ALWAYS HAVE AN ADEQUATE SUPPLY ON HAND AND ALWAYS USE NEW GASKETS OF THE CORRECT MATERIAL AND SIZE AS IDENTIFIED ON THE EQUIPMENT PARTS DRAWING.
2. IMPROPERLY MADE-UP THREADED PIPE JOINTS. SEE CHLORINE GAS HANDLING MANUAL FOR RECOMMENDED PROCEDURE.

EXCEPT IN CASES OF LEAK DETECTION OR CALIBRATION ADJUSTMENTS, THE CHLORINE GAS SUPPLY MUST BE SHUT OFF AT THE GAS SUPPLY CONTAINERS AND THE CHLORINE GAS IN THE SYSTEM EXHAUSTED BEFORE SERVICING THE EQUIPMENT.

USE ONLY EVOQUA WATER TECHNOLOGIES LISTED PARTS, EXCEPT FOR COMMERCIALY AVAILABLE PARTS AS IDENTIFIED ON THE PARTS LIST. THE USE OF UNLISTED PARTS CAN RESULT IN EQUIPMENT MALFUNCTIONS HAVE HAZARDOUS CONSEQUENCES.

DO NOT DISCARD THIS INSTRUCTION BOOK UPON COMPLETION OF INSTALLATION. INFORMATION PROVIDED IS ESSENTIAL TO PROPER AND SAFE OPERATION AND MAINTENANCE.

ADDITIONAL OR REPLACEMENT COPIES OF THIS INSTRUCTION BOOK ARE AVAILABLE FROM:

Evoqua Water Technologies
725 Wooten Road
Colorado Springs, CO 80915
Phone: (800) 524-6324

NOTE

Minor part number changes may be incorporated into Evoqua Water Technologies products from time to time that are not immediately reflected in the instruction book. If such a change apparently has been made in your equipment and does not appear to be reflected in your instruction book, contact your local Evoqua Water Technologies sales office for information.

Please include the equipment serial number in all correspondence. It is essential for effective communication and proper equipment identification.

GAS PRESSURE REDUCING VALVE

VERY IMPORTANT SAFETY PRECAUTIONS - SULFUR DIOXIDE

This page provides very important safety information related to safety in installation, operation, and maintenance of this equipment.

WARNING

TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, OBSERVE THE FOLLOWING:

THIS EQUIPMENT SHOULD BE INSTALLED, OPERATED, AND SERVICED ONLY BY TRAINED, QUALIFIED PERSONNEL WHO ARE THOROUGHLY FAMILIAR WITH THE ENTIRE CONTENTS OF THIS INSTRUCTION BOOK AND THE SULFUR DIOXIDE GAS HANDLING MANUAL.

EXPOSURE TO SULFUR DIOXIDE GAS IN LOW CONCENTRATION PRODUCES AN IRRITATING EFFECT ON THE MUCOUS MEMBRANES OF THE EYES, NOSE, THROAT, AND LUNGS. EXPOSURE TO HIGHER CONCENTRATION PRODUCES A SUFFOCATING EFFECT.

DO NOT TOLERATE ANY SULFUR DIOXIDE LEAKS. SULFUR DIOXIDE LEAKS NEVER GET BETTER. SULFUR DIOXIDE LEAKS ALWAYS GET PROGRESSIVELY WORSE IF THEY ARE NOT PROMPTLY CORRECTED. IT IS RECOMMENDED PRACTICE TO HAVE AN APPROVED GAS MASK AVAILABLE WHEN MAKING LEAK CHECKS.

AS SOON AS THERE IS ANY INDICATION OF THE PRESENCE OF SULFUR DIOXIDE IN THE AIR, TAKE IMMEDIATE STEPS TO CORRECT THE CONDITION.

IMPORTANT INFORMATION RELATED TO SAFETY OF SULFUR DIOXIDE EQUIPMENT INSTALLATIONS IS PROVIDED IN THE SULFUR DIOXIDE GAS HANDLING MANUAL. IN THE INTEREST OF SAFE OPERATIONS, AND TO AVOID THE POSSIBILITY OF PERSONAL INJURY, THIS INFORMATION MUST BE READ, UNDERSTOOD, AND PRACTICED BY EQUIPMENT OPERATORS AND THEIR SUPERVISORS.

AT TIME OF INITIAL INSTALLATION, WHEN SULFUR DIOXIDE SUPPLY LINES HAVE BEEN DISCONNECTED FOR ANY REASON, AND ON A ROUTINE DAILY BASIS, THOROUGHLY CHECK ALL JOINTS, CONNECTIONS, AND EQUIPMENT FOR POSSIBLE LEAKS, AND IMMEDIATELY CORRECT ANY THAT MAY BE FOUND.

WHEN ANY CONNECTION IS BROKEN EVEN FOR A SHORT TIME, IMMEDIATELY PLUG THE RESULTANT OPENINGS WITH A RUBBER STOPPER OR EQUIVALENT TO PREVENT THE ENTRANCE OF MOISTURE. MOISTURE MUST BE EXCLUDED FROM ANY PART OF THE EQUIPMENT THAT IS NORMALLY EXPOSED TO DRY SULFUR DIOXIDE ONLY. WHILE DRY SULFUR DIOXIDE IS NON-CORROSIVE, MOIST SULFUR DIOXIDE IS EXTREMELY CORROSIVE TO MANY COMMON METALS, SUCH AS BRASS, COPPER, OR STEEL.

THE TWO MOST COMMON CAUSES OF SULFUR DIOXIDE PIPING LEAKS ARE:

1. RE-USE OF GASKETS. THIS SHOULD NEVER BE DONE. ALWAYS HAVE AN ADEQUATE SUPPLY ON HAND AND ALWAYS USE NEW GASKETS OF THE CORRECT MATERIAL AND SIZE AS IDENTIFIED ON THE EQUIPMENT PARTS DRAWINGS.
2. IMPROPERLY MADE-UP THREADED PIPE JOINTS. JOINTS SHOULD BE MADE UP USING A SUITABLE THREAD DOPE OR FLUOROCARBON PLASTIC TAPE.

GAS PRESSURE REDUCING VALVE

VERY IMPORTANT SAFETY PRECAUTIONS - SULFUR DIOXIDE (CONT'D)

USE ONLY EVOQUA WATER TECHNOLOGIES LISTED PARTS, EXCEPT FOR THOSE COMMERCIALY AVAILABLE PARTS THAT ARE IDENTIFIED BY COMPLETE DESCRIPTION ON PARTS LIST. THE USE OF UNLISTED PARTS CAN RESULT IN EQUIPMENT MALFUNCTIONS, AND CAUSE POSSIBLE SEVERE PERSONAL INJURY.

EXCEPT IN CASES OF LEAK DETECTION OR CALIBRATION ADJUSTMENTS, THE SULFUR DIOXIDE GAS SUPPLY MUST BE SHUT OFF AT THE GAS SUPPLY CONTAINER(S) AND THE SULFUR DIOXIDE GAS IN THE SYSTEM MUST BE COMPLETELY EXHAUSTED BEFORE SERVICING THE EQUIPMENT.

DO NOT DISCARD THIS INSTRUCTION BOOK UPON COMPLETION OF INSTALLATION. INFORMATION PROVIDED IS ESSENTIAL TO PROPER AND SAFE OPERATION AND MAINTENANCE.

ADDITIONAL OR REPLACEMENT COPIES OF THIS INSTRUCTION BOOK ARE AVAILABLE FROM:

Evoqua Water Technologies
725 Wooten Road
Colorado Springs, CO 80915
Phone: (800) 524-6324

NOTE

Minor part number changes may be incorporated into Evoqua Water Technologies products from time to time that are not immediately reflected in the instruction book. If such a change apparently has been made in your equipment and does not appear to be reflected in your instruction book, contact your local Evoqua Water Technologies sales office for information.

Please include the equipment serial number in all correspondence. It is essential for effective communication and proper equipment identification.

GAS PRESSURE REDUCING VALVE



PROTECT YOUR EQUIPMENT INVESTMENT

MINIMIZE DOWNTIME

**ORDER A PREVENTIVE MAINTENANCE KIT NOW ...
KEEP ONE ON HAND**

Quality Equipment	+	Preventive Maintenance	=	Dependable Operation Minimum Downtime
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There's no question about it.

Equipment that is properly maintained is dependable equipment.
It will give optimum performance with minimum unscheduled downtime.

Evoqua Water Technologies manufactures quality equipment designed for performance and reliability. Each product is carefully tested and inspected before shipment to ensure that it meets our high standards.

Our equipment is engineered for easy maintenance. To ensure maximum service life and minimize unscheduled repairs, we recommend a program of regular preventive maintenance, as described in the Service section of this book. To support this program, we developed standard parts kits. These kits can also be used for minor emergency repairs to minimize downtime.

We recommend that these kits be available in your stock at all times. When the complete kit or any of its parts are used, the kit should be replaced immediately.

Preventive maintenance kits may be ordered directly from the company that supplied your equipment, or they may be ordered directly from Evoqua Water Technologies. For ordering numbers, refer to the parts list at the rear of this book.

GAS PRESSURE REDUCING VALVE

PREVENTIVE MAINTENANCE SCHEDULE AND RECORD OF PERFORMANCE

This equipment should receive preventive maintenance on a one (1) year cycle.* It is recommended that the following table be used to plan, schedule, and record this important work.

Date of Installation	
-----------------------------	--

Preventive Maintenance Log	
Schedule Date	Date Performed

***NOTE:** This is the recommended cycle. Your local operating conditions may call for more frequent preventive maintenance.



PROTECT YOUR EQUIPMENT INVESTMENT

MINIMIZE DOWNTIME

ORDER A PREVENTIVE MAINTENANCE KIT NOW ...

KEEP ONE ON HAND

GAS PRESSURE REDUCING VALVE

REGIONAL OFFICES

INSTALLATION, OPERATION, MAINTENANCE, AND SERVICE INFORMATION

Direct any questions concerning this equipment that are not answered in the instruction book to the Reseller from whom the equipment was purchased. If the equipment was purchased directly from Evoqua Water Technologies, Colorado Springs, CO contact the office indicated below.

UNITED STATES

725 Wooten Road
Colorado Springs, CO 80915
TEL: (800) 524-6324

CANADA

If the equipment was purchased directly from Evoqua Water Technologies, Canada, contact the nearest office indicated below.

ONTARIO

Evoqua Water Technologies Ltd.
2045 Drew Road
Mississauga, Ontario
L5S 1S4
(905) 944-2800

QUEBEC

Evoqua Technologies des Eaux Itée
505 Levy Street
St. Laurent, Quebec
H4R 2N9
(450) 582-4266

GAS PRESSURE REDUCING VALVE

1 TECHNICAL DATA

Capacity	
Chlorine	2000 or 10,000 lb/24 hr
Sulfur Dioxide	1900 or 9500 lb/24 hr
Operating Range	From 100% to 1% of rated capacity
Maximum Inlet Pressure	560 psi
Maximum Regulated Outlet Pressure	60 psi
Maximum Allowable Downstream Pressure	560 psi
Accuracy of Regulated Outlet Pressure	± 5 psi
Weight	32 lb

2 INSTALLATION



WARNING: THIS VALVE DELIVERS GAS UNDER PRESSURE. TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO EQUIPMENT, USE METAL TUBING OR PIPE AND CONNECT ONLY TO EQUIPMENT THAT WILL WITHSTAND THE PRESSURE.

NOTE: Before installing and operating the chlorine pressure reducing valve, the operator should be completely familiar with the contents of the CHLORINE HANDLING MANUAL (furnished as a part of this instruction book) or similar manual covering sulfur dioxide, which may be obtained from suppliers of this gas or from the Compressed Gas Association, Inc.

Chlorine gas at the pressure of the supply container will reliquefy at a temperature slightly lower than the temperature of the supply container, whereas at a pressure of 30 psi, reliquefaction will not occur until the temperature drops below 22°F (65°F for sulfur dioxide). Therefore, locate the reducing valve close to the gas supply and adjust it to a pressure near 30 psi to afford maximum protection to the equipment.

Piping for chlorine (or sulfur dioxide) supply, where the chlorine (or sulfur dioxide) is under pressure, should conform to Chlorine Institute or Compressed Gas Association recommendations. Plastic tubing and pipe are not recommended and should not be used.

Dimensions for mounting the valve are given on Dwg. 50.185.110.020. Select the location at an elevation higher than the outlet of the gas container. Be sure the connecting line from the container to the gas pressure reducing valve is

GAS PRESSURE REDUCING VALVE

on a continuous upward gradient to permit drainage back to the container in the event of reliquefaction ahead of the reducing valve.



WARNING: IF VALVE IS TO BE MOUNTED ON A LOCALLY FABRICATED BRACKET OR ON EVOQUA WATER TECHNOLOGIES BRACKET P58752, REMOVE ONLY THOSE FOUR SCREWS REQUIRED TO ATTACH VALVE TO BRACKET. TO PREVENT VALVE SEGMENTS FROM SHIFTING, WHICH WILL CAUSE DAMAGE TO DIAPHRAGM AND GAS LEAKAGE, POSSIBLY CAUSING SEVERE PERSONAL INJURY OR FURTHER EQUIPMENT DAMAGE, DO NOT DISTURB REMAINING SCREWS.

NOTE: In a bracket installation, the screws going through the bracket should be 1/4-inch longer than the rest. Install the valve in a vertical (upright) position wherever possible. If vertical installation is not possible, the valve can be tilted from vertical but never more than 90 degrees. Installation of the valve in any position other than vertical will necessitate more frequent cleaning.

3 ADJUSTMENT

The valve is factory-set to deliver gas at 30 psi pressure. If adjustment is necessary, turn the adjusting screw clockwise (as viewed looking down at the adjusting screw) for higher pressure or counterclockwise for lower pressure.

4 THEORY OF OPERATION

The Series 50-185 Gas Pressure Reducing Valve is a balanced-diaphragm type. Supply pressure enters the inlet port of the valve and builds up against the diaphragm. When the build-up pressure overcomes the opposing spring compression, the diaphragm moves. Movement of the diaphragm positions the stem assembly closer to the seat and throttles the supply pressure until the spring compression is balanced by the delivery pressure. When balanced, the desired regulated pressure results.

Regulated pressure is set by manually adjusting the spring compression.

GAS PRESSURE REDUCING VALVE

5 SERVICE

Maintenance consists of two periodically performed operations.

- Periodic Cleaning to remove contaminants and deposits.
- Periodic Preventive Maintenance to disassemble, inspect, and accomplish recommended parts replacement. A kit of replacement parts required for the periodic maintenance of the valve is available (listed at rear of this book).

PROTECT YOUR EQUIPMENT INVESTMENT
MINIMIZE DOWNTIME
REORDER A PREVENTIVE MAINTENANCE KIT NOW
KEEP ONE ON HAND

5.1 Periodic Cleaning

To ensure that all elements of your equipment are free of contaminants, it is recommended that the following check be made at the stated interval. This will minimize unscheduled disruptions of service and maximize service life. Before starting work, ensure that the appropriate replacement parts are on hand.

PERIODIC CLEANING SCHEDULE		
ITEM	INTERVAL	SERVICE
RETAINER AND SEAT	Monthly (or earlier if obstruction is suspected).	Clean (refer to paragraph 5.1.2).

5.1.1 Reliquefaction

If, during normal operation, the piping on the reduced pressure side of this valve becomes cold and/or sweats, or if frost forms, liquefied gas is present inside the pipe. This condition may be caused by liquid or “wet” gas coming from the evaporator or gas supply tank or because gas has condensed into liquid in the piping. To prevent the collection of liquid, ensure that the inlet piping is free of traps and is pitched downward from the valve back to the evaporator or supply tank. If the valve is properly set, gas condensation in the downstream piping can occur only if the valve (or the by-pass valve) leaks during periods of no gas flow and causes the reduced pressure to build up almost to supply pressure. If such leakage occurs, the retainer and seat unit must be cleaned.

5.1.2 Cleaning of Retainer and Seat Unit (See Dwg. 50.185.015.014)

NOTE: When pressure rises above valve set pressure, contamination of the retainer and seat is indicated and cleaning should be performed. When pressure falls below valve set pressure, obstruction of the strainer (15) is indicated and cleaning should be performed.

- a. Exhaust gas from lines and remove screws (11).
- b. Remove cap (12).
- c. Remove retainer and seat unit (14). Remove and discard lead gasket (13) and O-ring (8).
- d. Rinse the unit with warm water and a detergent. Pipe cleaners or soft brushes may facilitate cleaning, but wire brushes, scrapers, and the like should be avoided as they will damage the parts.
- e. All traces of detergent, moisture, or solvent must be removed from the parts before they are returned to service. Do not use heat on plastic parts.
- f. Reassemble the removed parts using a new lead gasket (13) and a new teflon O-ring (8).

5.2 Periodic Preventive Maintenance

To recondition the gas pressure reducing valve at one-year intervals, obtain Preventive Maintenance Kit U26217 and perform the procedures supplied with the kit.

5.3 Unscheduled Corrective Maintenance

5.3.1 Disassembly (See Dwg. 50.185.015.014)



WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, SHUT OFF THE GAS SUPPLY AT THE SUPPLY CYLINDER AND EXHAUST ALL GAS IN THE SYSTEM BEFORE SERVICING THE EQUIPMENT.

- a. Disconnect gas line at the valve. Plug gas line to prevent any moisture from entering the line.
- b. Move the valve to a suitable work area.
- c. Place the valve in a vise, gripping it by cap (12).
- d. Remove adjusting screw (25).
- e. Remove eight screws (2) and nuts (18).

GAS PRESSURE REDUCING VALVE

- f. Carefully lift off bonnet (24).

NOTE: If diaphragm (4) is stuck to bonnet carefully peel it off.

- g. Remove spring seat (23) and spring (22).
- h. Remove segments (3) from groove in segment holder (1).
- i. Lift out diaphragm assembly.
- j. Remove O-ring (6) from lower body (20).
- k. Remove nut (21).
- l. Remove segment holder.
- m. Lift off Hypalon diaphragm (4) and Kynar diaphragm (5).
- n. Remove O-ring (7) from vacuum support plate (19).

5.3.2 Inspection

After the disassembled parts are cleaned and prior to reassembly perform the following:

- a. Check for physical damage to removed parts (chipped, cracked, damaged threads, etc.). Replace damaged parts.
- b. Discard and replace all removed O-rings, seals, and gaskets.
- c. Check diaphragms for chafing or cracking. Replace damaged diaphragms.

5.3.3 Reassembly (See Dwg. 50.185.015.014)

Reassemble the valve as follows:

- a. Assemble the diaphragm parts first. Position the parts over the screw (17) in the following order: vacuum support plate (19) (with countersink up), O-ring (7), Kynar diaphragm (5), Hypalon diaphragm (4), segment holder (1) (with thin side of groove nearest the diaphragm), and nut (21). Tighten the nut, keeping the bolt holes in both diaphragms lined up with each other.
- b. Lay the body (2) right side up on a bench and carefully position the O-ring (6) in the groove. Lay the assembled diaphragm parts down on top of the body with the nut side up. Temporarily insert three or four screws (2) upward to keep all the bolt holes in line.

GAS PRESSURE REDUCING VALVE

- c. Position each of the 32 segments (3) in the groove in the segment holder (1) to form a continuous, close-spaced ring of segments. Arrange segments as shown on Dwg. 50.185.015.014.

NOTE: Ensure that each segment is properly engaged in the groove of segment holder (1). The entire assembly when in place, should have no open spaces which could deform the diaphragms. (See Dwg. 50.185.015.014.)

- d. Place spring (22) and spring seat (23) over nut (21) and carefully lower bonnet (24) down over the three or four bolts that have been used for alignment.

NOTE: To prevent damage to the diaphragm, each segment must rest within the offset ledge in the bonnet.

- e. Secure the bonnet to the body with eight screws (2) and nuts (18), installing the screws with the heads on the bonnet side. If a wall bracket is used, four longer bolts are required on the wall bracket side.

NOTE: In order to obtain uniform compression of the diaphragms, progressively cross-tighten body screws (2) in at least three passes from finger-tight to wrench-tight. Avoid excessive wrench turning at any one point at one time.

- f. Assemble the retainer and seat unit parts as shown in the parts drawing. Exercise care that both the teflon O-ring (8) and the lead gasket (13) are properly seated, that the back end of the stem unit (16) is in the hole in the guide bushing (10), and that the four screws (11) are tightened evenly.

- g. Install the adjusting screw (25) until it touches the spring seat.

- h. Adjust the valve pressure as follows:

- (1) Close discharge from valve.
- (2) Connect an inert gas pressure source (air, carbon dioxide, or nitrogen) to the valve inlet.
- (3) Rotate adjusting screw (25) until 30 psi discharge pressure is achieved.
- (4) Check for leaks by observing any drop in pressure on the gauge. If a leak is observed, correct and retest.

GAS PRESSURE REDUCING VALVE

WARNING LABEL

The following warning label is attached to the equipment:

L2336: THIS VALVE DELIVERS GAS UNDER PRESSURE.

TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO EQUIPMENT, USE METAL TUBING OR PIPE AND CONNECT ONLY TO EQUIPMENT THAT WILL WITHSTAND PRESSURE.

SEE INSTRUCTION BOOK FOR FULL DETAILS BEFORE INSTALLATION.

GAS PRESSURE REDUCING VALVE

PREVENTIVE MAINTENANCE KITS AND SPARE PARTS LIST

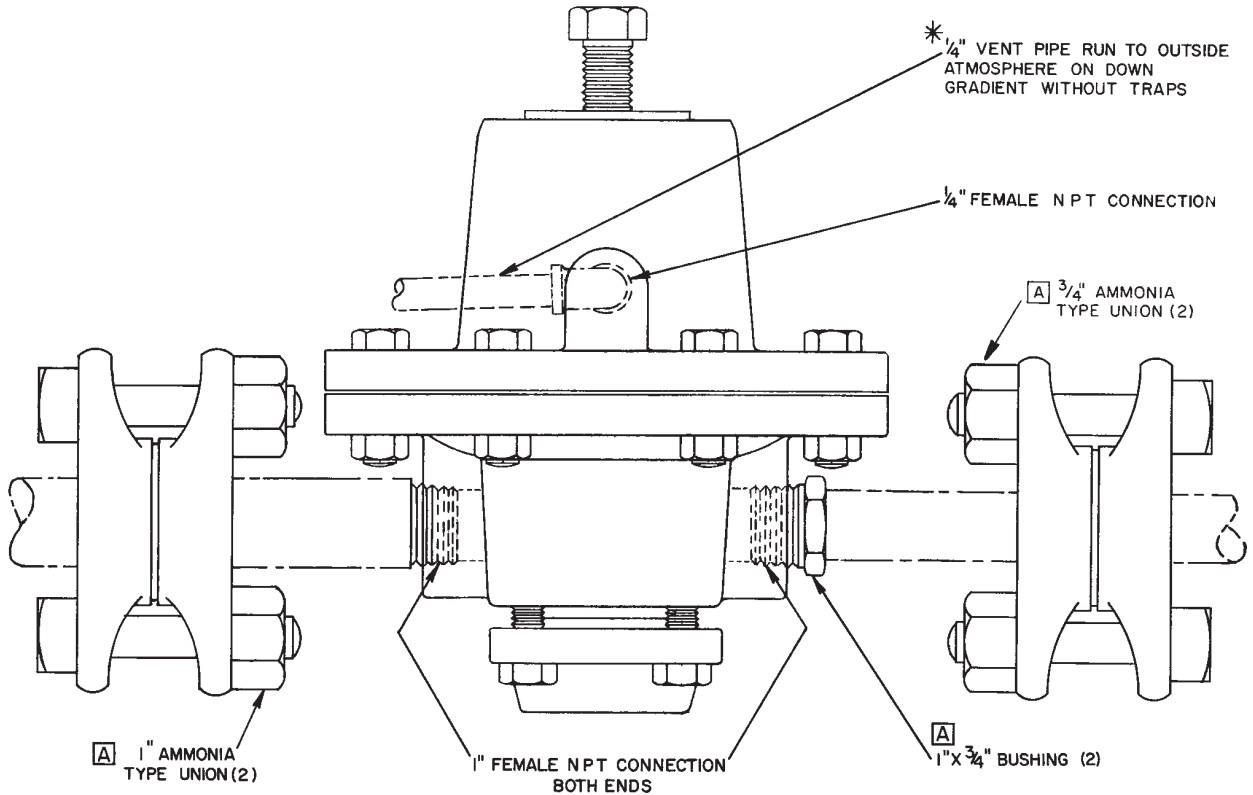
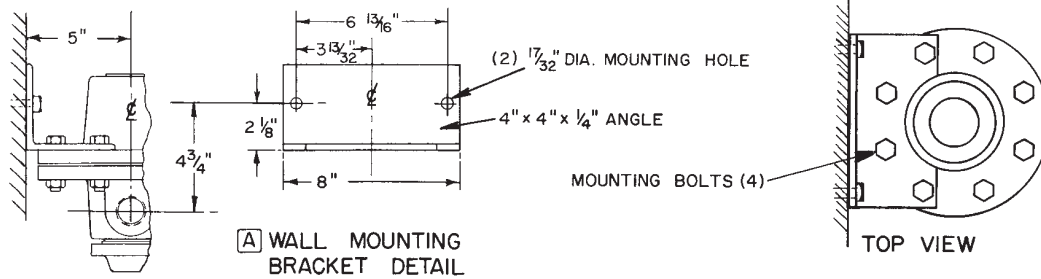
SERIES 50-185 GAS PRESSURE REDUCING VALVE

<u>DESCRIPTION</u>	<u>PART NO.</u>
Preventive Maintenance Kit	U26217

ADDITIONAL SPARE PARTS

<u>QTY.</u>	<u>DESCRIPTION</u>	<u>PART NO.</u>
1	Lead Gasket	P41869
1	O-Ring	PXB42310
1	O-Ring	PXA26345
1	O-Ring	PXA52565
1	Diaphragm	P52554
1	Diaphragm	P52555
1	Strainer	P41866

GAS PRESSURE REDUCING VALVE



10000 LB./24 HR. CAPACITY

2000 LB./24 HR. CAPACITY

TYPICAL BOTH ENDS

TYPICAL BOTH ENDS

WARNING: * THE VENT LINE MUST TERMINATE IN AN AREA WHERE GAS FUMES CAN NOT CAUSE DAMAGE OR INJURY TO PERSONNEL. DO NOT TERMINATE VENT LINE AT A LOCATION ROUTINELY USED BY PERSONNEL, SUCH AS WORK AREAS OR PATHWAYS, NOR NEAR WINDOWS OR VENTILATION SYSTEM INTAKES.

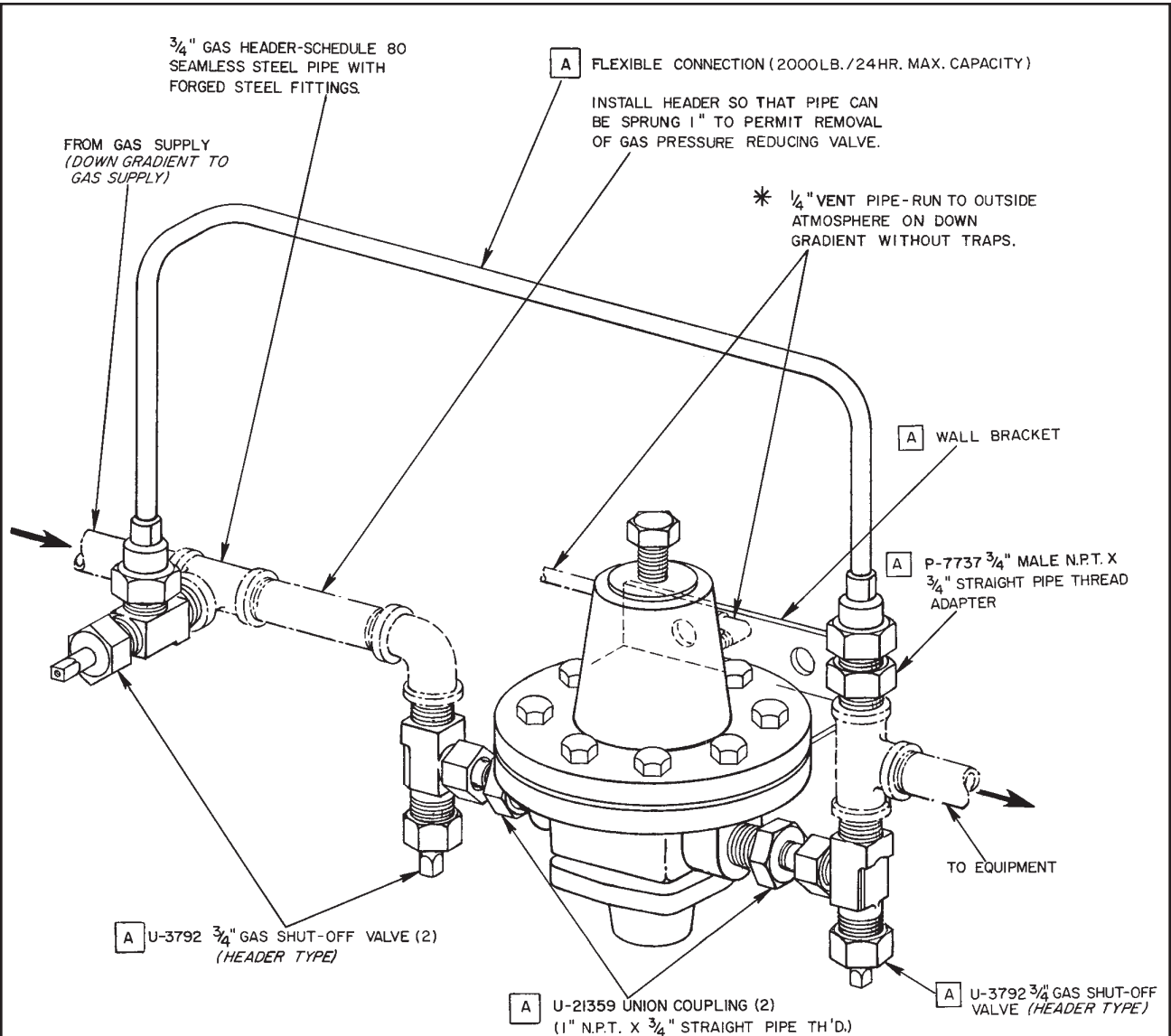
NOTE: ALL PIPING & FITTINGS SHOWN DOTTED TO BE FURNISHED BY CUSTOMER.
 [A] ACCESSORY ITEM FURNISHED ONLY IF SPECIFICALLY LISTED IN QUOTATION.

SERIES 50-185 GAS PRESSURE REDUCING VALVE - TYPICAL INSTALLATION
 Manual Control

50.185.110.020

ISSUE 4 3-90

GAS PRESSURE REDUCING VALVE



WARNING: * THE VENT LINE MUST TERMINATE IN AN AREA WHERE GAS FUMES CANNOT CAUSE DAMAGE OR INJURY TO PERSONNEL. DO NOT TERMINATE VENT LINE AT A LOCATION ROUTINELY USED BY PERSONNEL, SUCH AS WORK AREAS OR PATHWAYS, NOR NEAR WINDOWS OR VENTILATION SYSTEM INTAKES.

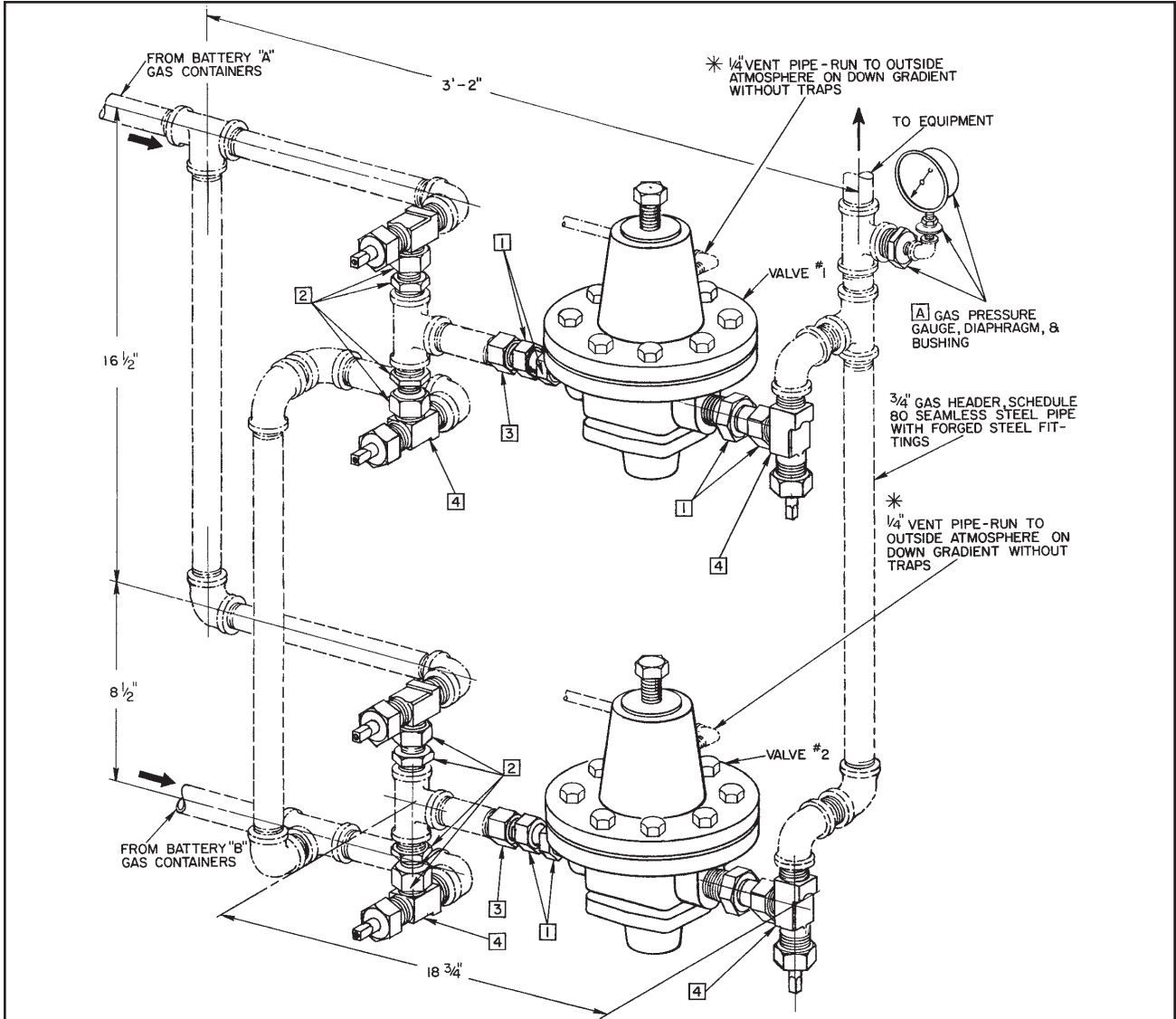
NOTE: ALL PIPING & FITTINGS SHOWN DOTTED TO BE FURNISHED BY CUSTOMER.
 (A) ACCESSORY ITEM FURNISHED ONLY IF SPECIFICALLY LISTED IN QUOTATION.

SERIES 50-185 GAS PRESSURE REDUCING VALVE - TYPICAL INSTALLATION
 With By-Pass

50.185.110.030

ISSUE 3 12-87

GAS PRESSURE REDUCING VALVE



[A] ITEM	PART NO.	NO. REQ'D	DESCRIPTION	[A] ITEM	PART NO.	NO. REQ'D	DESCRIPTION
1	U21359	4	UNION COUPLING-1 N.P.T. X 3/4" STRAIGHT PIPE THREAD	3	P3348	2	ADAPTER-3/4" N.P.T. X 3/4" STRAIGHT PIPE THREAD
2	U9737	4	UNION COUPLING-3/4" N.P.T. X 3/4" STRAIGHT PIPE THREAD	4	U3792	6	3/4" GAS SHUT-OFF VALVE (HEADER TYPE)

METHOD OF OPERATION -AUTOMATIC CUT-IN

VALVE (1) DRAWING GAS FROM BATTERY "A" IS ADJUSTED FOR A REDUCED PRESSURE APPROX. 10 TO 20 LBS. HIGHER THAN VALVE (2), WHICH IS VALVED TO DRAW GAS FROM BATTERY "B". GAS WILL FLOW THRU VALVE (1) UNTIL REDUCED PRESSURE FALLS BELOW SETTING OF VALVE (2). GAS WILL THEN FLOW IN MAJOR QUANTITY THRU VALVE (2) WHILE MINOR FLOW CONTINUES THRU VALVE (1) UNTIL BATTERY "A" & BATTERY "B" SUPPLY IS COMPLETELY EXHAUSTED. AFTER EMPTY CONTAINERS IN BATTERY "A" HAVE BEEN REPLACED WITH FULL ONES, THE SHUT-OFF VALVES AHEAD OF BOTH VALVES SHOULD BE REVERSED SO THAT VALVE (1) DRAWS FROM BATTERY "B" AND VALVE (2) DRAWS FROM BATTERY "A".

NOTE: [A] ACCESSORY ITEM FURNISHED ONLY IF SPECIFICALLY LISTED IN QUOTATION.
 ALL DIMENSIONS ARE SUGGESTED ONLY, AND MAY VARY TO SUIT CONDITIONS.
 ALL PIPING & FITTINGS SHOWN DOTTED TO BE FURNISHED BY CUSTOMER.

WARNING: * THE VENT LINE MUST TERMINATE IN AN AREA WHERE GAS FUMES CANNOT CAUSE DAMAGE OR INJURY TO PERSONNEL. DO NOT TERMINATE VENT LINE AT A LOCATION ROUTINELY USED BY PERSONNEL, SUCH AS WORK AREAS OR PATHWAYS, NOR NEAR WINDOWS OR VENTILATION SYSTEM INTAKES.

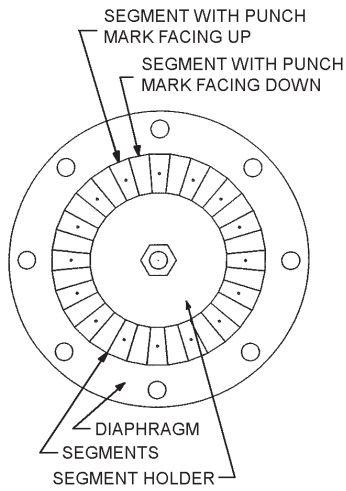
SERIES 50-185 GAS PRESSURE REDUCING VALVE - TYPICAL INSTALLATION

Manual Control Installed in Parallel for Battery Operation

50.185.110.040

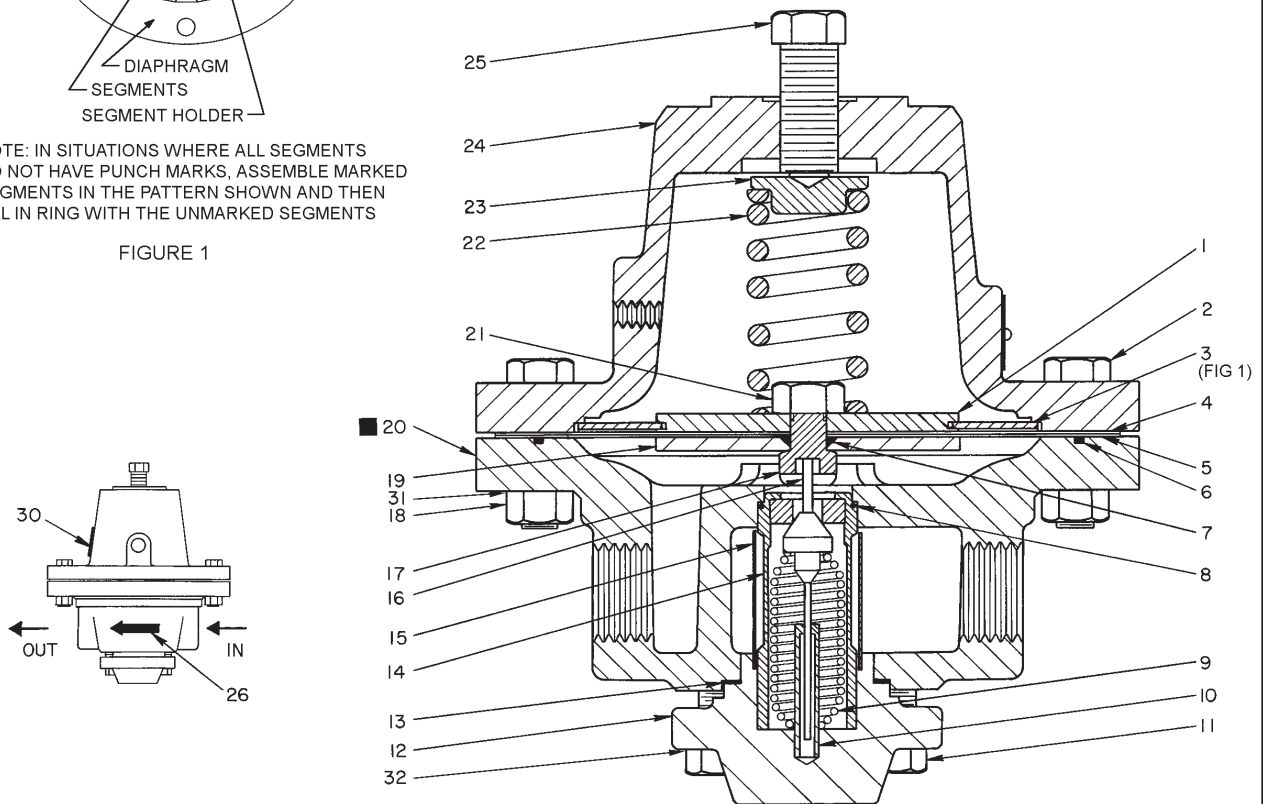
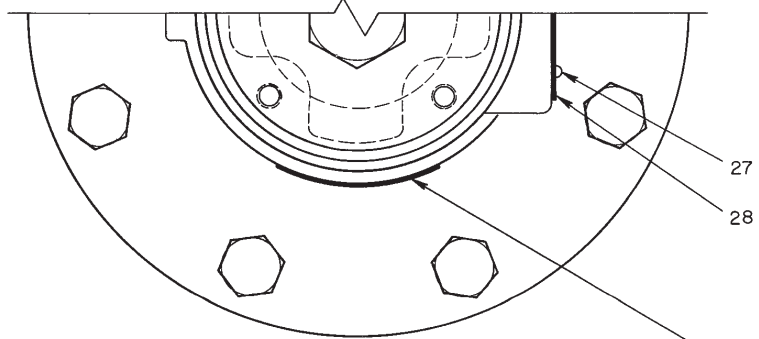
ISSUE 2 7-82

GAS PRESSURE REDUCING VALVE



NOTE: IN SITUATIONS WHERE ALL SEGMENTS DO NOT HAVE PUNCH MARKS, ASSEMBLE MARKED SEGMENTS IN THE PATTERN SHOWN AND THEN FILL IN RING WITH THE UNMARKED SEGMENTS

FIGURE 1



NOTE: FOR PARTS LIST, SEE DWG. 50.185.015.014B.
 ■ ROTATED 90° FOR CLARITY.
 ▲ CAPACITIES SHOWN ARE FOR CHLORINE AND SULFUR DIOXIDE.

▲ U28505 - 2000 LBS. MAX. CAP. 60 PSI MAX.; ▲ U28506 - 10,000 LBS. MAX. CAP. 60 PSI MAX.

**SERIES 50-185 GAS PRESSURE REDUCING VALVE - PARTS
 Manual Control**

50.185.015.014A

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GAS PRESSURE REDUCING VALVE

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	P 51547	1	SEGMENT HOLDER
2	PC 2537	8	MACH.SCREW (HEX.HD.,STL.) 1/2"-13 x 2" LG.
3	P 51546	32	SEGMENT
4	P 52554	1	OUTER DIAPHRAGM (HYPALON)
5	P 52555	1	INNER DIAPHRAGM (KYNAR)
6	PXA52565	1	O-RING (259) VITON, 6-1/4"ID x 6-1/2"OD
7	PXA26345	1	O-RING (112) VITON, 1/2"ID x 11/16"OD
8	PXB42310	1	O-RING (122) 1-1/8"ID x 1-5/16"OD x 3/32" DIA.
9	P 38593	1	SPRING
10	P 41870	1	BUSHING GUIDE
11	P 6582	4	MACH.SCREW (HEX.HD.,STEEL) 1/2"-13 x 1-1/2" LG.
12	P 58501	1	CAP
13	P 41869	1	LEAD GASKET
14	U 19788	1	RETAINER & SEAT UNIT (5/16" SEAT) 2,000 PPD
	OR		
	U 19787	1	RETAINER & SEAT UNIT (9/16" SEAT) 10,000 PPD
15	P 41866	1	STRAINER
16	U 28202	1	STEM UNIT
17	P 52564	1	DIAPHRAGM SCREW
18	P 889	8	HEX. NUT (STL.) 1/2"-13
19	P 52563	1	VACUUM SUPPORT PLATE
20	P 58487	1	BODY
21	P 47719	1	HEX. NUT (BRASS) 1/2"-20
22	P 1752	1	SPRING
23	P 41868	1	SPRING SEAT
24	P 58499	1	BONNET
25	P 41871	1	SCREW ADJ. STEM
26	P 51359	2	ARROW DECAL
27	PC22839	2	SELF-TAPPING SCREW (RD.HD.,HDN,STL.) #4-40 x 1/4" LG.
28	P 55292	1	NAMEPLATE
29	L 2336	1	LABEL
30	P 54516	1	LABEL
31	P 33350	8	WASHER
32	P 7358	4	WASHER

NOTE: ▲ CAPACITIES SHOWN ARE FOR CHLORINE AND SULFUR DIOXIDE.

WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

▲ U28505 - 2000 LBS. MAX. CAP. 60 PSI MAX.; ▲ U28506 - 10,000 LBS. MAX. CAP. 60 PSI MAX.

SERIES 50-185 GAS PRESSURE REDUCING VALVE - PARTS LIST

Manual Control

50.185.015.014B

ISSUE 11 1-04

**CHLORINE HANDLING
MANUAL**
(Cl₂)

BOOK NO. WT.025.000.001.UA.IM.0614

REGIONAL OFFICES

INSTALLATION, OPERATION, MAINTENANCE, AND SERVICE INFORMATION

Direct any questions concerning this equipment that are not answered in the instruction book to the Reseller from whom the equipment was purchased. If the equipment was purchased directly from Evoqua Water Technologies, Colorado Springs, CO contact the office indicated below.

UNITED STATES

725 Wooten Road
Colorado Springs, CO 80915
TEL: (800) 524-6324

CANADA

If the equipment was purchased directly from Evoqua Water Technologies, Canada, contact the nearest office indicated below.

ONTARIO

Evoqua Water Technologies Ltd.
2045 Drew Road
Mississauga, Ontario
L5S 1S4
(905) 944-2800

QUEBEC

Evoqua Technologies des Eaux Itée
505 Levy Street
St. Laurent, Quebec
H4R 2N9
(450) 582-4266

CHLORINE HANDLING MANUAL

CHLORINE HANDLING MANUAL

WARNING:

CHLORINE IS A HAZARDOUS CHEMICAL THAT CAN CAUSE INJURY AND DEATH IF NOT HANDLED PROPERLY. THIS MANUAL CONTAINS ONLY GENERAL INFORMATION ON THE PHYSICAL PROPERTIES, STORAGE, AND HANDLING OF CHLORINE. IT IS NOT INTENDED TO REPLACE OR LIMIT SAFETY PROCEDURES IN YOUR FACILITY.

SAFETY PROCEDURES IN AN INDUSTRIAL SETTING MUST BE DESIGNED IN ACCORDANCE WITH ALL GOVERNMENTAL REGULATIONS AND NATIONAL SAFETY CODES, AFTER GIVING FULL CONSIDERATION TO THE SPECIFIC NEEDS OF THE INDUSTRIAL FACILITY INVOLVED.

EVOQUA WATER TECHNOLOGIES CANNOT ANTICIPATE THE SPECIFIC SAFETY PROCEDURES REQUIRED AT EVERY INDUSTRIAL FACILITY. ACCORDINGLY, EVOQUA WATER TECHNOLOGIES DOES NOT GUARANTEE THAT SAFETY PROCEDURES DESIGNED IN ACCORDANCE WITH THIS MANUAL WILL COMPLETELY ELIMINATE HAZARDS AND THUS ASSUMES NO LIABILITY FOR ACCIDENTS THAT MAY OCCUR IN YOUR FACILITY.

READ THIS ENTIRE MANUAL AND BE FULLY FAMILIAR WITH YOUR EQUIPMENT AND YOUR ENTIRE INDUSTRIAL SYSTEM SO THAT THE SAFETY PROCEDURES YOU ESTABLISH WILL MEET THE NEEDS OF THE EMPLOYEES IN YOUR FACILITY. READING ONLY PART OF THE MANUAL WILL NOT HELP YOU ANALYZE THE NEEDS OF YOUR FACILITY. CONTACT YOUR CHLORINE SUPPLIER, THE CHLORINE INSTITUTE, INC., OR SIMILAR ORGANIZATION TO OBTAIN A MATERIAL SAFETY DATA SHEET (MSDS) AND MORE DETAILED INFORMATION ON CHLORINE. INFORMATION IS AVAILABLE FROM: THE CHLORINE INSTITUTE, INC., 1300 WILSON BOULEVARD, ARLINGTON, VA 22209.

PLEASE NOTE THE PUBLICATION DATE AND POSSIBLE OBSOLESCENCE OF THIS MATERIAL AS A RESULT OF SCIENTIFIC AND MEDICAL DEVELOPMENTS AFTER THE DATE OF PUBLICATION. THIS APPLIES TO ALL MATERIALS YOU REVIEW IN THE COURSE OF DEVELOPING SAFETY PROCEDURES FOR USE AT YOUR FACILITY.

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1 INTRODUCTION

This manual discusses the characteristics, storage and handling of chlorine used with Evoqua Water Technologies equipment. Chlorine is used with Evoqua Water Technologies equipment primarily as a disinfectant in water or wastewater treatment.

WARNING:

CHLORINE IS HAZARDOUS. TO AVOID SEVERE PERSONAL INJURY OR DEATH BY SUFFOCATION, READ THIS MANUAL AND THE CHLORINE SUPPLIER'S PRECAUTIONS BEFORE HANDLING OR CONNECTING CHLORINE TO EVOQUA WATER TECHNOLOGIES EQUIPMENT.

WHEN WORKING WITH CHLORINE:

ENSURE THAT APPROVED, SELF-CONTAINED BREATHING APPARATUS IS ALWAYS AVAILABLE AND PERSONNEL ARE PROPERLY TRAINED IN ITS USE.

ENSURE THAT SAFETY EQUIPMENT, SUCH AS VENTILATION FANS AND BREATHING APPARATUS, IS INSPECTED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

ENSURE THAT APPROPRIATE PLACARDS AND WARNING SIGNS ARE IN PLACE AND PROMINENTLY DISPLAYED IN THE AREAS WHERE THE GAS IS STORED.

IN CASES OF ACCIDENT:

USE SAFETY EQUIPMENT TO PROTECT THE RESCUER AND MOVE VICTIM TO FRESH AIR. IF BREATHING HAS STOPPED, START ARTIFICIAL RESPIRATION IMMEDIATELY.

IF HEART HAS STOPPED, START CPR (CARDIOPULMONARY RESUSCITATION) IMMEDIATELY. IN ALL CASES, OBTAIN MEDICAL ATTENTION AS SOON AS POSSIBLE.

TO AVOID ACCIDENTAL GAS RELEASE:

KNOWLEDGEABLE DESIGN PERSONNEL SHOULD OVERSEE AND APPROVE EQUIPMENT INSTALLATION AND SUITABILITY OF THE SYSTEM FOR WHICH IT IS INTENDED. QUALIFIED PERSONNEL SHOULD PERFORM PERIODIC INSPECTION TO ENSURE PROPER MAINTENANCE OF THE EQUIPMENT.

MONITOR SAFETY PROGRAMS AND CONDUCT PERIODIC TRAINING PROGRAMS, ESPECIALLY ON EMERGENCY SITUATIONS. SAFETY PROGRAMS ARE AVAILABLE FROM YOUR GAS SUPPLIER.

LOCAL LAWS:

UNDER NO CIRCUMSTANCES SHOULD THE INFORMATION IN THIS BOOK BE CONSTRUED AS SUBSTITUTING FOR OR SUPERSEDING ANY LOCAL, STATE, OR FEDERAL LAWS AND REGULATIONS CONCERNING THE STORAGE, HANDLING, OR USE OF CHLORINE.

CHLORINE HANDLING MANUAL

2 TECHNICAL DATA AND CHARACTERISTICS OF CHLORINE

The following general information on chlorine may be useful in planning a chlorinator installation; however, a specific application may require more information than that included here. For further information, consult your chlorine supplier, the Chlorine Institute, Inc., or similar organization.

Chlorine in commerce is a liquefied gas under pressure. It is a clear, amber-colored liquid. The gas has a greenish-yellow color and a strong, pungent odor. It is an irritant to the skin and respiratory system. In the moisture-free state at ordinary temperatures, it is relatively non-corrosive. In the presence of moisture, however, it is highly corrosive. Accordingly, every precaution should be taken to avoid leaks, to stop them promptly if they occur, and to keep moisture out of valves, tubing, etc., not specifically designed to handle moist chlorine. Among the important physical properties of chlorine are:

Specific Gravity, Dry Gas
2.48 at 32° F and 1 atm referred to air.

Specific Gravity, Liquid
1.47 at 32° F and 53 . 5 psia.

Liquid to Gas volume Ratio
1:456.5 at 32° F and 1 atm.

Latent heat of Vaporization
123.9 Btu per lb at boiling point, -29.2° F.

Specific Volume, Dry Gas
1 lb = 4.99 of at 32° F and 1 atm.

Specific Volume, Liquid
1 lb = 0.0109 cf at 32° F and 53.5 psia.

Weight, Dry Gas
1 cf = 0.2006 lb at 32° F and 1 atm.

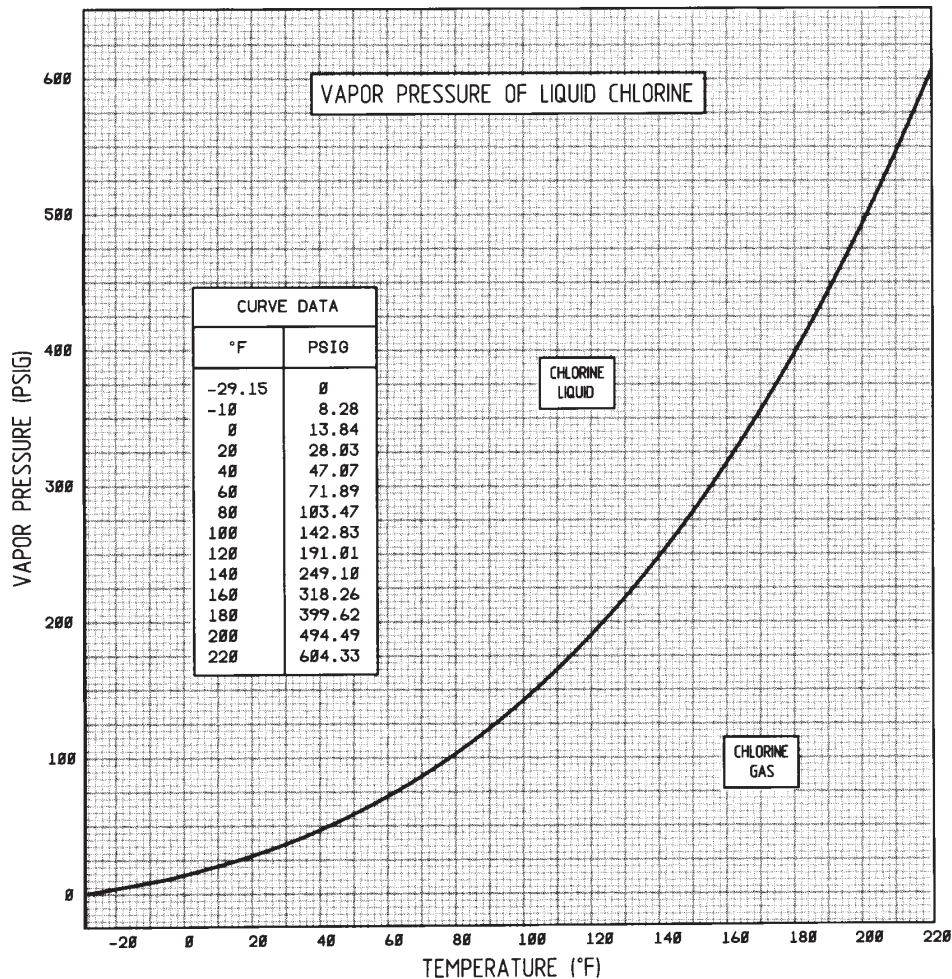


Figure 1 – Chlorine Pressure vs Temperature

SOURCE: THE CHLORINE MANUAL, FIFTH EDITION, PUBLISHED BY THE CHLORINE INSTITUTE, INC.

CHLORINE HANDLING MANUAL

Weight, Liquid

1 cf = 91.56 lb at 32° F.

Solubility in Water*

6.93 lbs./100 gals at 60° F and 1 atm.

Pressure vs Temperature

See Figure 1

***NOTE: Theoretical values shown. Actual solubility in water based on chlorinator performance has proven to be 3500 ppm or 2.92 lbs/100 gals maximum.**

Chlorine is an oxidizing agent and will support combustion but is not explosive or flammable. Many organic chemicals will react with chlorine, some violently. Steel will ignite spontaneously in the presence of chlorine at 483° F.

3 SUPPLY CONTAINERS

Table 1 gives details on the supply containers most commonly used with Evoqua Water Technologies equipment.

Some large installations that would normally use single unit tank cars but are not serviced by railroad facilities use tank motor vehicles (tank trailers) which usually range in capacity from 15 to 22 tons.

All supply containers must conform to appropriate Department of Transportation (DOT) and Canadian Transport Commission (CTC) regulations. It is the responsibility of the supply container manufacturer and the chlorine supplier to meet these requirements.

3.1 RATES

In general, using a remote vacuum type chlorinator, the maximum sustained gas withdrawal rate at which chlorine may be taken from a 100 or 150 pound cylinder is one pound per day per degree Fahrenheit (1.0 lb/24 hrs/°F). The corresponding rate for ton containers is about 8.0 lbs/24 hrs/°F. At an assumed liquid temperature of 70° F (and using a remote vacuum type chlorinator) the above figures translate into 70 lbs/24 hrs for cylinders and 560 lbs/24 hrs for ton containers. For a direct feed cylinder pressure operated chlorinator these rates become 42 and 336 lbs/24 hrs respectively. These rates can be increased substantially for brief periods. Do not place containers in a water bath or apply direct heat in order to permit higher withdrawal rates.

It is not practical to withdraw chlorine as a gas from tank cars (or tank trailers).

3.1.1 MANIFOLDING FOR GAS WITHDRAWAL

When higher gas withdrawal rates are required, cylinders or the gas valves (upper) of ton containers may be manifolded. A typical arrangement for manifolding cylinders is shown in Figure 2.

If cylinders or ton containers are manifolded, it is essential that all supply containers be at the same temperature to prevent the transfer of liquid chlorine from a warmer container to a cooler container, possibly resulting in a container becoming overfilled through reliquefaction of chlorine in the cooler container.

TABLE 1 - CHLORINE CONTAINER INFORMATION

TYPE OF CONTAINER	NET WEIGHT	TARE WEIGHT	GROSS WEIGHT	OUTSIDE DIAMETER	LENGTH
CYLINDERS	100 lb	63 - 115 lb	163 - 215 lb	8-1/4" - 10-3/4"	3'3-1/2" - 4'11"
	150 lb	85 - 140 lb	235 - 290 lb	10-1/4" - 10-3/4"	4'5" - 4'8"
TON CONTAINER	2000 lb	1300 - 1650 lb	330 - 3650 lb	2'6"	6'7-3/4" - 6'10-1/2"
SINGLE UNIT TANK CARS	16 tons	-	-	10'5" - 12'0"	32'2" - 33'3"
	30 tons	-	-	12'4-1/2" - 13'7"	33'10" - 35'11-1/2"
	55 tons	-	-	14'3" - 15'1"	29'9" - 43'0"
	85 tons	-	-	14'11" - 15'1"	43'7" - 50'0"
	90 tons	-	-	14'11" - 15'1"	45'8" - 47'2"

Dimensional data from Chlorine Manual, Fifth Edition, published by the Chlorine Institute, Inc.

(1) The 150 lb cylinder is generally most readily available. Either the 100 lb or 150 lb size may be shipped full or empty via truck or rail in small lots or in full truck or carloads.

(2) Chlorine from Single Unit Tank Cars is generally unloaded directly from the car as needed in order to eliminate the necessity of storage tanks. Cars are leased to the consumer during this period and are consigned to private sidings only. Two parallel tracks are recommended to facilitate the handling of cars and to permit continuous operation without shut-down periods while cars are being switched.

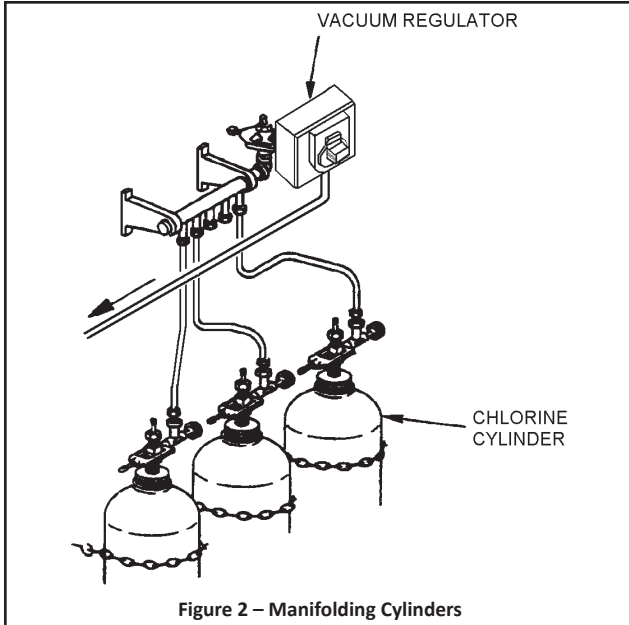


Figure 2 – Manifolding Cylinders

3.2 MAXIMUM LIQUID WITHDRAWAL RATE

The generally accepted alternate to manifolding ton containers is to withdraw liquid chlorine from the lower valve and use an evaporator. By this means, a ton container can be emptied in approximately five hours, which is equivalent to 9600 lbs/24 hrs.

Liquid can be withdrawn from tank cars at up to nearly 8,000 pounds per hour, or 192,000 pounds per 24 hours.

3.2.1 MANIFOLDING FOR LIQUID WITHDRAWAL

WARNING: IN ACCORDANCE WITH CHLORINE INSTITUTE RECOMMENDATIONS, DO NOT MANIFOLD TON CONTAINERS FOR SIMULTANEOUS LIQUID CHLORINE WITHDRAWAL. THIS MANIFOLDING CAN CAUSE OVER-PRESSURIZATION AND RUPTURE.

3.3 CONTAINER VALVES

Standard cylinder and ton container valves are identical in design, except that the cylinder valve includes a pressure relief device. Cylinder valves are shown in Figure 3 and ton container valves in Figure 4.

See Figure 5 for captive yoke type auxiliary container valves (valve connection style #820, recognized by the Compressed Gas Association as the only acceptable means of connecting to container valves). The external threads on the container valve are used only for securing the protective cap.

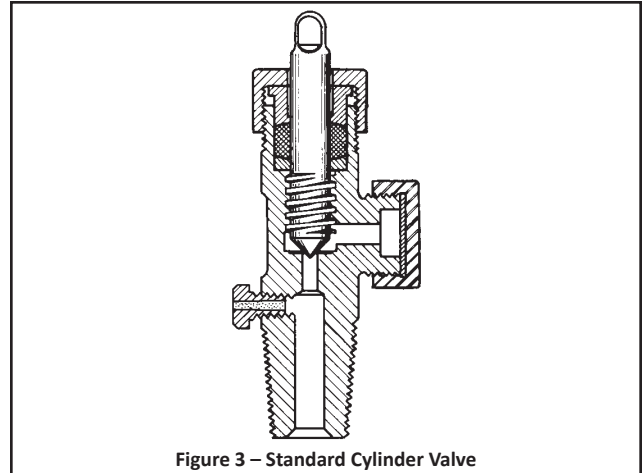


Figure 3 – Standard Cylinder Valve

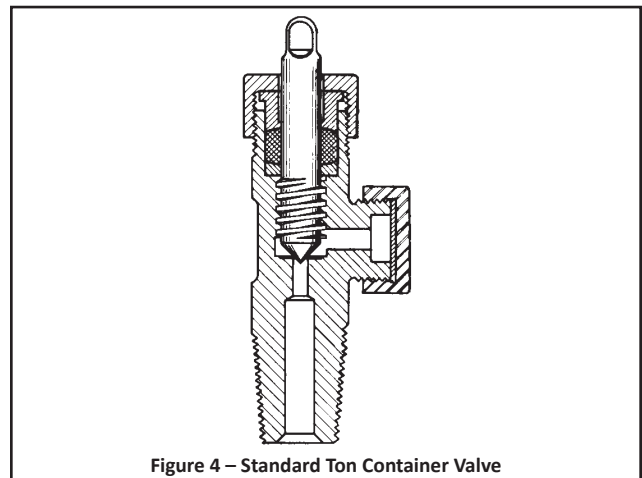


Figure 4 – Standard Ton Container Valve

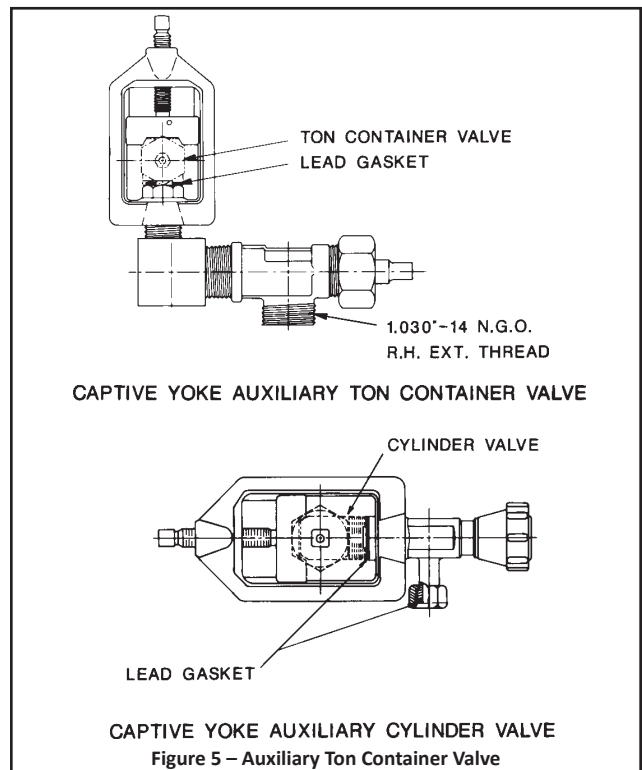


Figure 5 – Auxiliary Ton Container Valve

Cylinders are equipped with one valve that is normally used for gas withdrawal. Ton containers are equipped with two valves, as shown in Figure 6.

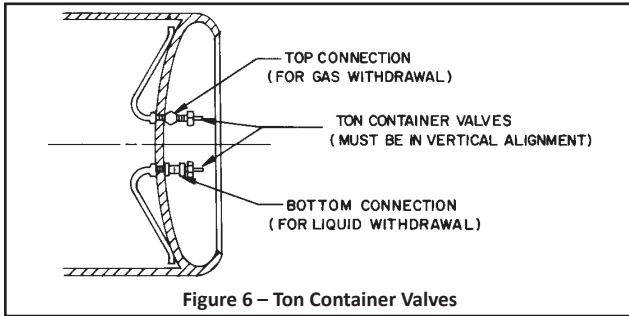


Figure 6 – Ton Container Valves

The upper valve is used for gas withdrawal and the lower valve for liquid withdrawal. Tank cars are equipped with four standard angle valves, as shown in Figure 7.

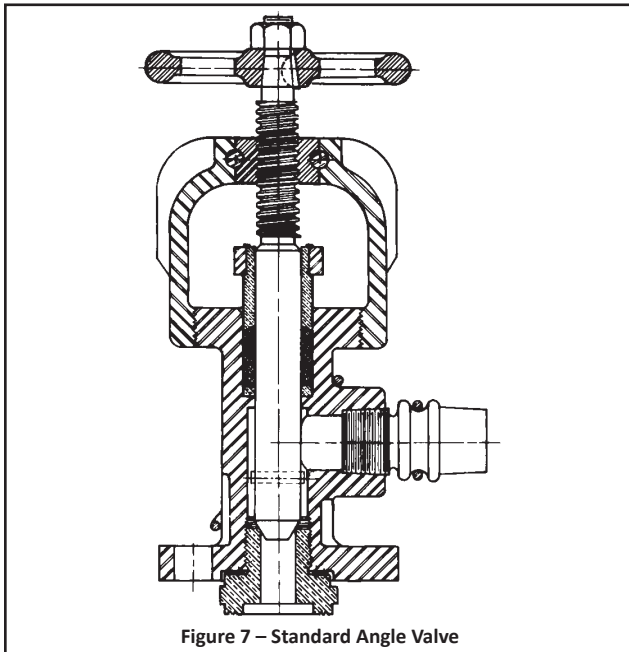


Figure 7 – Standard Angle Valve

Outlet is one-inch female ANSI Standard taper pipe thread. The liquid withdrawal valves are located on the longitudinal center line of the tank car. The valves on the transverse center line are connected to the vapor space and are used to obtain chlorine gas under pressure for testing the piping or for air padding the tank car.

3.4 PRESSURE RELIEF DEVICES

All chlorine supply containers are equipped with some type of device for relief of pressure. Cylinder valves have a fusible metal plug screwed into the body of the valve, as shown in Figure 3. The fusible metal melts when the temperature

increases to 158-165° F to relieve pressure and prevent rupture of the cylinder.

Ton containers are equipped with six fusible metal plugs (see Figure 8), three of which are in each end, spaced 120 degrees apart.

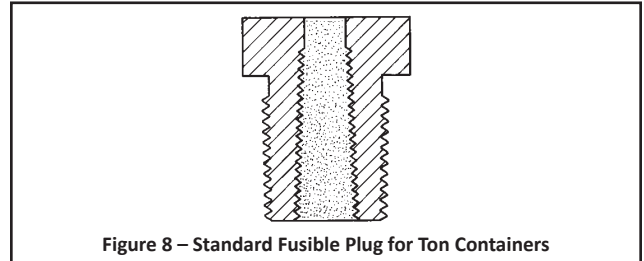


Figure 8 – Standard Fusible Plug for Ton Containers

Tank cars have an excess-flow valve (see Figure 9) located under each liquid valve. While this valve may close during a catastrophic pipe line failure, its main function is to close automatically if the angle valve is broken off in transit. Tank cars also have a pressure relief device (see Figure 10) located in the center of the manway. The relief level varies with the type of car or tank.

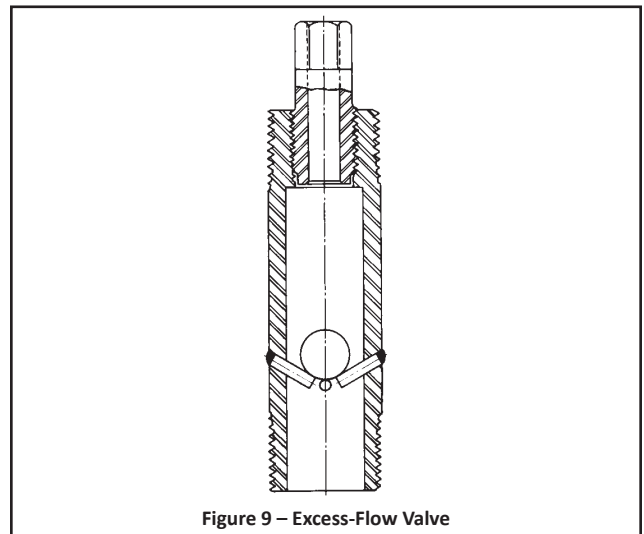


Figure 9 – Excess-Flow Valve

3.5 STORAGE OF CONTAINERS

Store chlorine containers of any type under cover and in cool, well ventilated locations protected from fire hazards and adequately protected from extreme weather conditions. During the summer months, full containers should be shielded from the direct rays of the sun, otherwise a dangerous build-up of pressure might result (see Figure 1 and Paragraph 3.3). If stored out of doors, keep containers in fenced-off areas for protection. Avoid storage in subsurface areas because chlorine is heavier than air and will not readily rise from

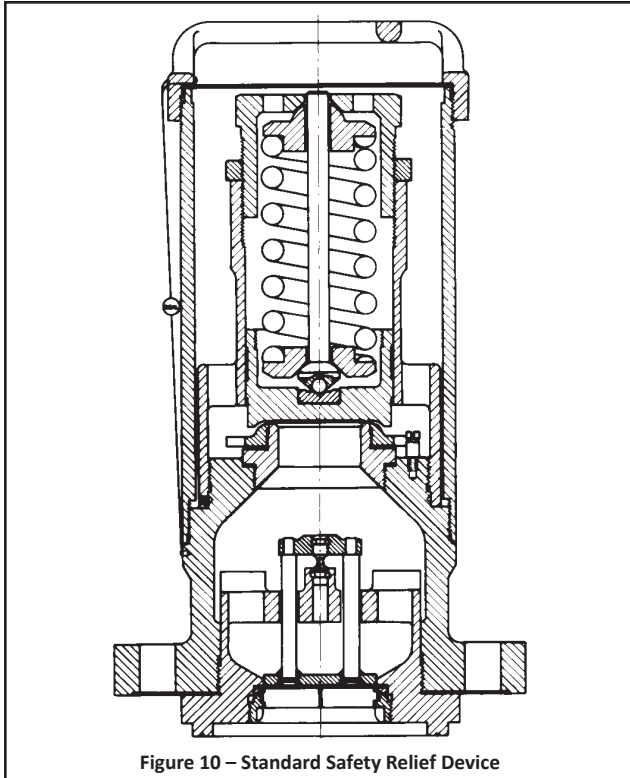


Figure 10 – Standard Safety Relief Device

subsurface locations should leaks occur. Do not store or use chlorine containers near other chemicals or gases.

WARNING: STORE CYLINDERS IN AN UPRIGHT POSITION. TO AVOID SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, SUPPLY CYLINDERS MUST BE SECURED IN SUCH A MANNER (E.G., CHAIN) AS TO PREVENT THEIR BEING KNOCKED OVER. TON CONTAINERS MUST BE SECURED IN SUCH A MANNER (E.G., CROCKS) TO PREVENT THEIR ROLLING OUT OF PLACE.

Do not remove the protective cap or hood from cylinders or ton containers until they are ready to be put in actual use. Do not store containers in a heavily traveled area where physical contact damage could occur.

It is essential that areas used to house chlorine containers or equipment be continuously monitored for the presence of chlorine in the air. This may be a requirement of applicable laws and/or regulations.

When containers are moved from a storage area to an area where they will be used, allow sufficient time to stabilize the temperature, and therefore the pressure, of the container and the chlorine before it is used.

The chlorine inventory depends to a large extent on local availability. Consult with chlorine suppliers in the area; review appropriate fire code requirements concerning storage of oxidizing materials and other applicable laws and regulations.

When planning space for stored containers, sufficient space must be allowed for empty containers. The best way to determine the amount of chlorine remaining in a container is to weigh the container continuously on a scale. This also makes it possible to record the amount of chlorine used. Portable or dormant scales in beam, dial, or digital types and with varying platform sizes are available.

WARNING: ALWAYS REMOVE WHEELS AND AXLES OF PORTABLE SCALES SO THAT THE SCALE CANNOT MOVE WHEN CYLINDERS ARE ON THE PLATFORM.

Preferably, scales for cylinders should be installed with their platform flush with the floor to eliminate the necessity of lifting the cylinders. Some low profile scales such as the Wallace & Tiernan® Cylinder Scale are low enough that cylinders can be placed on the scale without lifting. Others are installed with ramps. If scales are pit mounted, a trapped drain should be provided.

Scales for ton containers are usually installed above the floor, since ton containers are usually handled by overhead conveyor. Many of these scales do not have platforms since the ton containers are usually supported by cradles or trunnions.

Special high-capacity scales are provided at some installations using tank cars. These scales are usually pit mounted below the railroad siding with the dial or digital unit housed above ground beside the track.

Some of the dial or digital scales are equipped with loss-of-weight recording systems providing a permanent record of chlorine usage.

3.6 HANDLING CONTAINERS

Always handle chlorine containers with utmost care. To prevent injury or damage, do not drop chlorine containers and do not permit containers to strike each other or other objects. To prevent damage to the valve, valve protecting caps or hoods must always be in place when containers are moved.

Handle cylinders with a simple two-wheel hand truck of the barrel pattern. Hand trucks should be well balanced and equipped with chains or clamps to prevent the cylinders from falling off the truck.

WARNING: NEVER LIFT CYLINDERS BY THE VALVE PROTECTING HOOD. THE HOOD MAY SEPARATE FROM THE CYLINDER, CAUSING THE CYLINDER TO FALL.

Never lift cylinders by sling or magnetic devices. If lifting is necessary, use a specially designed cradle. Contact your chlorine supplier for recommendations or information.

When moving ton containers, due consideration must be given to the fact that the liquid in the container represents a live load in addition to the dead load of the container and the liquid. The most accepted way of moving ton containers is by overhead conveyor and lifting beam (see Figure 11).

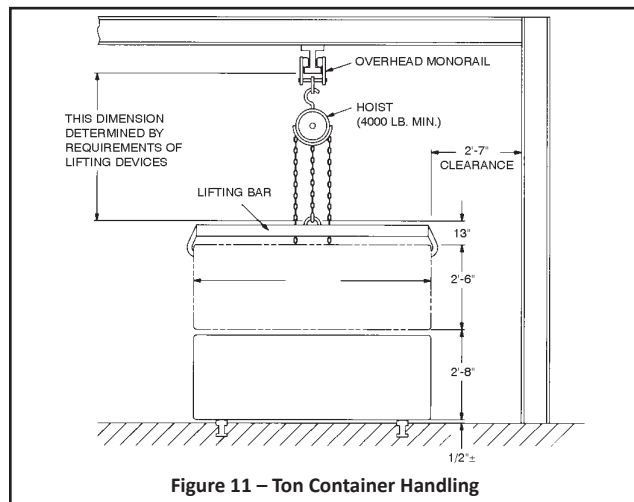


Figure 11 – Ton Container Handling

Rails or roller conveyors have also been used. Fork lift trucks, in addition to having adequate capacity, must have the containers restrained and be sufficiently stable to prevent tipping.

3.7 USING CONTAINERS

If containers have been stored in an area other than that in which they will be used, they should be allowed to stabilize at the new temperature before being used. Containers should always be used in the order in which they are received to avoid unnecessarily long storage and possible difficulty with valves that have not been opened or closed for too long a period.

WARNING: CYLINDERS ARE NORMALLY USED IN AN UPRIGHT POSITION FOR GAS WITHDRAWAL. TO AVOID SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, SUPPLY CYLINDERS MUST BE SECURED IN SUCH A MANNER (E.G., CHAIN) AS TO PREVENT THEIR BEING KNOCKED OVER. TON CONTAINERS MUST BE USED IN A HORIZONTAL POSITION WITH THE TWO VALVES IN A VERTICAL LINE. TON CONTAINERS MUST BE SECURED IN SUCH A MANNER (E.G., CHOCKS) TO PREVENT THEIR ROLLING OUT OF PLACE.

When withdrawing gas from a ton container, connection is made to the upper valve (see Figure 6). Liquid withdrawal is accomplished by connecting to the lower valve.

It is recommended that special 3/8-inch square box wrenches, rather than adjustable wrenches, be used for opening cylinder and ton container valves. Length of the wrench should not exceed eight inches. It is good practice to leave the wrench in place so the valve can be closed quickly in case of an emergency. Maximum discharge can be accomplished with one full turn of the valve. Excessive force must not be used in opening valves. Never strike the wrench with anything other than the heel of the hand. Loosening the packing nut a maximum of 1/2 turn is acceptable, provided the packing nut is tightened after the valve is operated. Contact your chlorine supplier if these procedures do not permit operation of the valve.

Angle valves on tank cars must be opened fully to aid the operation of the excess flow valve.

Always test for leaks before putting new containers in service. The system can be pressurized by opening the container valve and then closing it. The valve can be opened again after it is determined that there are no leaks.

WARNING: ALWAYS WEAR PROTECTIVE CLOTHING WHEN CHECKING FOR LEAKS. REFER TO "PERSONNEL SAFETY" FOR INFORMATION ON HEALTH HAZARDS AND SAFETY PRECAUTIONS.

It is not unusual during humid conditions for condensation to collect on the outside of the container. A buildup of frost on the container indicates that withdrawal rates are too high to permit the surrounding air to supply the heat necessary to evaporate the liquid chlorine. Increasing the circulation of room temperature air past the container may correct the condition. Do not apply direct heat to the container in any way. It may be necessary to shut off the container valve and permit it to warm up again before putting it back in service.

After emptying the container, the valve must be closed before disconnecting to prevent the entry of moisture. After disconnecting, the valve cap and the valve protecting cap or hood must be replaced before the container is moved. Empty containers should be segregated from full containers and should be tagged.

Tank cars are unloaded by means of one of the liquid valves. One of the gas valves can be connected to the system to permit pressure testing with gaseous chlorine rather than liquid. The flexible connection used for tank car unloading must be designed for and installed in such a manner to allow for the significant increase in height as the car unloads. Since

tank car pressure is the only force causing the chlorine to discharge, many cars are padded with dry air by the producer or the user. Reference to Chlorine Institute Pamphlet 66, Chlorine Tank Car Loading, Unloading, Air Padding, Hydrostatic Testing, should be made for information on user air padding. It is essential that air padding pressure be kept as low as possible for satisfactory operation of the chlorination equipment since excessive air padding pressures can have a negative impact on evaporator performance. The depletion of the liquid chlorine supply in the car is accompanied by a sharp drop in tank car pressure.

After the angle valve is closed and the discharge line emptied, the piping may be disconnected. The valve outlet plugs should be replaced and the discharge piping capped immediately.

4 PIPING

4.1 PIPING MATERIALS AND JOINTS

If the chlorinator capacity is low enough, the vacuum regulator or the complete chlorinator may be mounted directly on a cylinder or ton container valve, totally eliminating pressure piping. In this case, reference to the equipment instruction book provides all necessary details.

Pressure connections from all chlorine containers are normally made by means of flexible connections made of copper tubing. Use yoke type connections at container valves. The chlorinator or vacuum regulator instruction book should be referred to for details for use of flexible connections along with the required auxiliary cylinder or ton container valves, header valves, and auxiliary header valves (if required).

WARNING: ALWAYS REPLACE FLEXIBLE CONNECTIONS ANNUALLY (OR SOONER IF THERE IS EVIDENCE OF DEGRADATION).

The usual practice for chlorine liquid or gas pressure lines, at the commonly encountered pressures and temperatures at chlorinator installations, is the use of 3/4 or 1.0 inch schedule 80 carbon steel seamless pipe with Class 3000 forged steel fittings; two-bolt flanges (commonly referred to as oval ammonia unions) are also often used. Both screwed and socket welded construction are common. Threaded joints should be made up using litharge and glycerine for permanent joints, white lead or TFE tape for others.

To facilitate maintenance, the number of line valves should be kept to a minimum. Insulation is required only in those cases where it is necessary to prevent chlorine gas lines from becoming chilled, or liquid lines from becoming overheated.

More complete details, along with ASTM and ANSI specifications, can be obtained by referring to Chlorine Institute Pamphlet 6, Piping Systems For Dry Chlorine.

WARNING: TWO COMMON CAUSES OF CHLORINE PIPING LEAKS ARE:

1. RE-USE OF GASKETS. THIS SHOULD NEVER BE DONE. ALWAYS HAVE AN ADEQUATE SUPPLY ON HAND AND ALWAYS USE NEW GASKETS OF THE CORRECT MATERIAL AND SIZE AS IDENTIFIED ON THE EQUIPMENT PARTS DRAWING.

2. IMPROPERLY MADE-UP THREADED PIPE JOINTS. SEE CHLORINE INSTITUTE MANUAL OR PAMPHLET 6 FOR RECOMMENDED PROCEDURE.

4.2 GAS PIPING INSTALLATION REQUIREMENTS

Reliquefaction of a gas should be avoided. If liquid chlorine is carried downstream to the chlorinator or vacuum piping, it may soften the plastic components and affect their structural strength. Liquid can wash any collected contaminants into the vacuum regulator and can also cause erratic surging, freezing, and pressure release, which can damage the diaphragm and control valves. Cold conditions in a gas pipe line (cold to the touch, dripping of water condensed from the atmosphere, frost, ice) are an indication that liquid chlorine is present in the line and is flashing to gas. Refer to the proper guidelines that follow.

It is important to observe the correct temperature conditions in conducting chlorine gas under pressure from the location of the containers to the point of use. To avoid difficulty with reliquefaction of chlorine, pressure piping and control equipment receiving gas under pressure should be at a higher temperature than that of the chlorine containers. In general, a difference of 5° to 10° F is recommended.

Pitch pressure lines uphill from the gas source toward the chlorinators if possible.

Install a pressure reducing valve or the chlorinator vacuum regulator close to, but higher than, the source of gas. The use of a chlorine pressure reducing valve is also recommended in those localities where severe temperature changes are likely to be encountered during a 24-hour period.

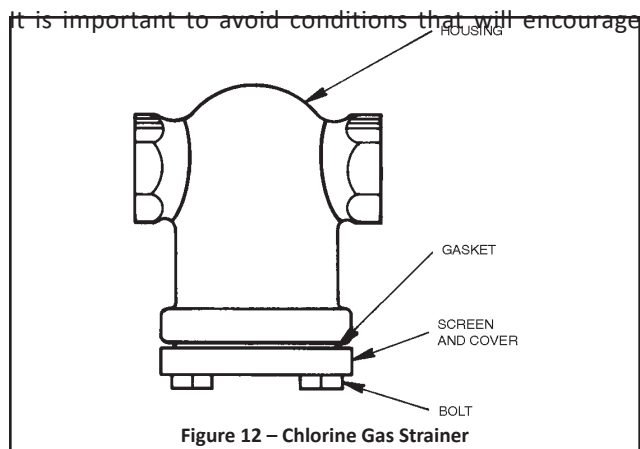
It is preferable to run chlorine pressure gas lines overhead through relatively warm areas rather than along the floor or through basement areas where lower temperatures may be encountered. Do not run these gas lines along exterior walls that may be cold in winter months. Do not run pressure gas lines under windows from which cold air descends in winter months.

If the source of gas is one or more ton containers connected to a manifold, install a drip leg of 1.0-inch schedule 80 seamless steel pipe approximately 18 inches long in a tee in the manifold with the lower end capped. Locate the drip leg immediately downstream of the last container connection to intercept the liquid that comes from the ton containers' gas education tubes when initially opened.

Gas may be withdrawn from two or more containers simultaneously provided all containers are at the same temperature. Refer to Paragraph 3.1.

The installation of chlorine gas strainers in pipe lines upstream from pressure reducing valves or vacuum regulators is a common practice. These strainers can also serve as traps for a small amount of liquid chlorine. Figure 12 illustrates a typical strainer.

4.3 LIQUID PIPING INSTALLATION REQUIREMENTS

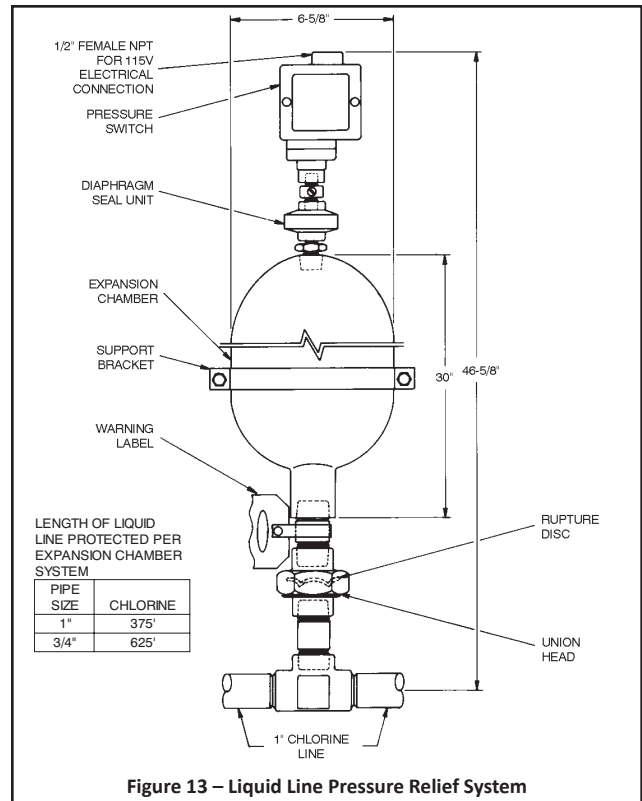


vaporization. Thus it is important to keep liquid chlorine lines as cool as, or cooler than, the containers themselves by eliminating restrictive fittings and always operating with fully opened line valves. Avoid running liquid chlorine lines through overheated areas where gasification is likely.

Valves in liquid chlorine lines should be kept to a minimum. It is particularly important to avoid situations where it is easy to close two valves in a line thus trapping liquid that, upon an increase in temperature, will expand and develop higher than acceptable pressures.

A liquid line pressure relief system (which includes a rupture disc and an expansion chamber) is required where liquid may be trapped in the line or where it is necessary to run lines a considerable distance. The relief system is detailed in Figure 13.

The expansion chamber provides an area for expansion in the event that valves at both ends of the line are closed. Relief system placement must be based not only on length of line but also placement of valves.



4.4 PRESSURE RELIEF AND VENT PIPING REQUIREMENTS

All pressure relief vent line systems must be treated as though they contain chlorine. Use the same materials for pressure relief vent lines as used for chlorine gas piping, unless the vent line is a combination pressure relief/vacuum relief line in which case the material must be suitable for moist chlorine gas (PVC or polyethylene tubing).

Vent lines must be run in such a way that moisture collecting traps are avoided. A continuous gradient is preferred. The end of all vent lines must be turned down and screened.

Manifolding of vent lines is an acceptable practice provided only like vents are manifolded (i.e., evaporator water vapor vents must be separate from gas pressure reducing valve pressure vents, etc.). The interior cross sectioned area of a common vent or pressure relief line should be approximately equal to the sum of the cross sectional areas of the individual vent lines.

WARNING: THE VENT LINE AND RELIEF LINE MUST TERMINATE IN AN AREA GAS FUMES CANNOT CAUSE INJURY TO PERSONNEL OR DAMAGE. DO NOT TERMINATE THE VENT LINE AND RELIEF LINE AT A LOCATION ROUTINELY USED BY PERSONNEL, SUCH AS WORK AREAS OR PATHWAYS NOR NEAR ANY WINDOWS OR VENTILATION SYSTEM INTAKES. IF AN AREA MEETING THESE REQUIREMENTS IS NOT AVAILABLE, REFER TO THE CHLORINE INSTITUTE'S CHLORINE MANUAL AND PAMPHLET NO. 9 FOR ALTERNATE METHOD OF RELIEF DISPOSAL.

4.5 VALVES

Yoke type auxiliary cylinder, yoke type auxiliary ton container, and header valves are described adequately in the chlorinator or vacuum regulator instruction book.

Line valves are used to isolate alternate sources of supply (manifolded banks of ton containers or tank cars), individual evaporators or pressure type chlorinators. Sufficient line valves should be provided for flexibility of system operation consistent with the recommended practice of eliminating redundant or unnecessary valves.

Valves are usually of approximately globe pattern as shown in Figure 14 or ball type as shown in Figure 15.

Care should be taken that only valves designed by the manufacturer specifically for chlorine service are used. Ball valves must include a provision for venting the cavity in the closed position to the upstream side.

4.6 PRESSURE GAUGES AND SWITCHES

Whenever pressure gauges and switches are used in chlorine liquid or gas lines, they must be of the type protected by a flanged diaphragm seal specifically designed for chlorine service to prevent the entry of chlorine into the gauge or

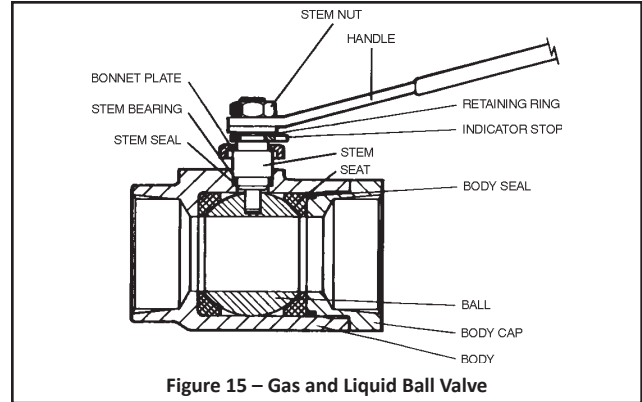


Figure 15 – Gas and Liquid Ball Valve

switch mechanism. The fill material must be suitable for chlorine service. The connection between the seal and the gauge or switch must not be broken. If the connection is inadvertently broken, the complete assembly must be discarded and replaced, unless it can be returned to the manufacturer for repair.

Frequently, valves are installed between chlorine lines and the gauge or switch diaphragm seal to permit removal without taking the line out of service. A means of relieving the pressure in the isolated piping, gauge, or switch is strongly recommended.

WARNING: RELEASING EVEN A SMALL AMOUNT OF LIQUID CHLORINE IS DANGEROUS AND REQUIRES EXTREME CAUTION TO AVOID SEVERE PERSONAL INJURY. ALWAYS USE PROTECTIVE EQUIPMENT WHEN RELIEVING PRESSURE, EVEN IN ISOLATED CHLORINE GAS PIPING.

Since small size line valves for chlorine are not readily available, many times a header valve is used as shown in Figure 16.

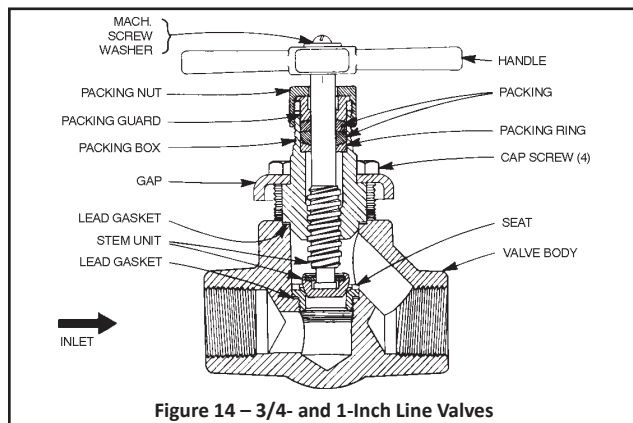


Figure 14 – 3/4- and 1-inch Line Valves

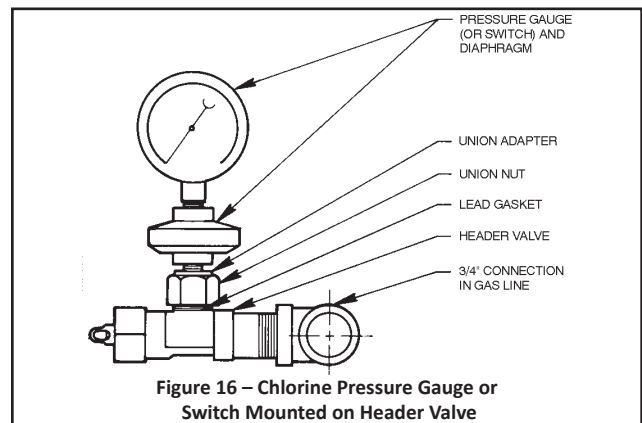


Figure 16 – Chlorine Pressure Gauge or Switch Mounted on Header Valve

4.7 PRESSURE RELIEF DEVICES

There are two types of pressure relief devices in use in chlorine piping systems. The first, as shown in Figure 13, is usually employed in liquid chlorine piping to protect the piping from rupture due to high pressure from thermal expansion of the liquid chlorine. It consists of a rupture disc that ruptures before the pipe line itself can rupture, an expansion chamber that allows for relief of the over-pressure condition without releasing chlorine to the atmosphere, and a pressure switch to warn of the disc rupture.

The second type, as shown in Figure 17, is usually used in gas piping at the evaporator discharge. This system consists of a rupture disc that keeps chlorine out of the valve during normal operation, a pressure relief valve, and a pressure switch to warn of disc rupture.

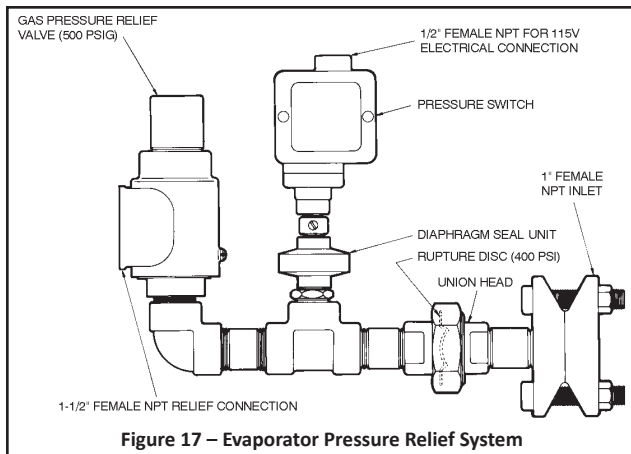


Figure 17 – Evaporator Pressure Relief System

WARNING: THE RELIEF LINE MUST TERMINATE IN AN AREA WHERE GAS FUMES CANNOT CAUSE DAMAGE OR INJURY TO PERSONNEL. DO NOT TERMINATE THE RELIEF LINE AT A LOCATION ROUTINELY USED BY PERSONNEL, SUCH AS WORK AREAS OR PATHWAYS, NOR NEAR WINDOWS OR VENTILATION SYSTEM INTAKES. IF AN AREA MEETING THESE REQUIREMENTS IS NOT AVAILABLE, REFER TO THE CHLORINE INSTITUTE'S CHLORINE MANUAL AND PAMPHLET NO. 9 FOR AN ALTERNATE METHOD OF RELIEF DISPOSAL.

4.8 PREPARATION FOR USE

Normal plumbing practices will result in the entry of cutting oils, greases, and other foreign materials into the piping.

In addition, the line will have been open to the atmosphere during construction, allowing moisture to enter. It is therefore essential that all piping be thoroughly cleaned and dried prior to exposure to chlorine.

WARNING: INCOMPLETE CLEANING CAN RESULT IN VIOLENT REACTIONS BETWEEN CHLORINE AND THESE MATERIALS.

Steam cleaning is an acceptable method for removal of the above materials. Provision must be made for removal of condensate and foreign materials. For alternate methods if steam is not available, refer to Chlorine Institute Pamphlet 6, Piping Systems for Dry Chlorine.

After proper cleaning, all chlorine piping should be hydrostatically tested to one and one half times the expected maximum operating pressure. Prior to testing, all gauges, switches, rupture discs, etc., that could be damaged during testing must be removed and connections plugged. Any moisture absorbing packing or gaskets left in the system during hydrostatic testing must be removed and replaced with new packing or gaskets. After hydrostatic testing, it is essential that all piping be thoroughly dried with inert gas (e.g., nitrogen) or dry air having a dew point of -40° F or below. The dew point of the air or gas leaving the piping must be checked and drying continued until the dew point is at or below -40° F, which may require quite some time.

WARNING: MOISTURE MUST BE REMOVED FROM ANY PART OF THE EQUIPMENT THAT IS NORMALLY EXPOSED TO DRY CHLORINE ONLY. WHILE DRY CHLORINE IS NON-CORROSIVE, MOIST CHLORINE IS EXTREMELY CORROSIVE TO COMMON METALS, SUCH AS BRASS OR STEEL, POSSIBLY RESULTING IN A LEAK AND SEVERE PERSONAL INJURY. ALSO, IF WATER IS TRAPPED IN A SECTION OF PIPING OR EQUIPMENT, SUBSEQUENT HEATING OR FREEZING OF THE WATER MAY RESULT IN HIGH ENOUGH PRESSURE TO RUPTURE THE PIPING OR EQUIPMENT, POSSIBLY CAUSING SEVERE PERSONAL INJURY.

A very acceptable alternate to hydrostatic testing, if proper facilities do not exist for drying, is to test with nitrogen or dry air having a dew point of -40° F or below. The same provision of removing equipment that could be damaged by test pressure applies.

WARNING: TO AVOID SEVERE PERSONAL INJURY, BEFORE PLACING THE PIPING SYSTEM INTO SERVICE, PRESSURE TEST WITH CHLORINE GAS, NOT LIQUID. EACH VOLUME OF CHLORINE LIQUID THAT LEAKS AND THEN EVAPORATES RESULTS IN APPROXIMATELY 460 VOLUMES OF CHLORINE GAS.

The chlorine container valve should be opened only slightly during this phase of testing or preferably closed again after pressurizing the system. The piping should be tested in the smallest sections permitted by the existing valves to minimize

the discharge of chlorine through any leaks.

WARNING: IT IS ESSENTIAL THAT PROPER BREATHING APPARATUS BE AVAILABLE BEFORE CHLORINE IS ADMITTED TO ANY PIPING SYSTEM OR EQUIPMENT. THIS APPARATUS WILL BE DISCUSSED FURTHER UNDER "PERSONNEL SAFETY".

Chlorine leaks are best located using a dauber moistened with commercial 26° Baume' aqueous ammonia (household ammonia is not strong enough). A white cloud will be formed at the site of any leak. A plastic squeeze bottle that directs ammonia vapor, not liquid, at the joint being tested may also be used.

When a leak is detected, the system must be depressurized before corrective action is taken. The best method of depressurizing the system is through one of the chlorinators. At least one chlorinator must be readily available for this purpose before testing with chlorine begins.

5 PERSONNEL SAFETY

5.1 GENERAL

Proper consideration of personnel safety begins with the provision of properly sized and arranged housing so that operating personnel have adequate room to perform their duties. It is preferable that any room used for chlorine storage or equipment have two doors that open outward and that are equipped with panic bars.

Rooms housing chlorination equipment, and chlorine containers that are "in service" or "in reserve", should be heated when the room temperature falls below 50° F. Comfortable working temperatures of 65° to 75° F are recommended for the chlorine equipment room. The temperature of the chlorine container room (if separate) should normally be 5° to 10° F lower. All common methods of heating are acceptable, provided that care is taken to prevent overheating of chlorine containers. Radiators should not be located adjacent to containers. If space heaters are used, the warm air should be deflected away from the containers. Outside windows should be located or screened so that the rays of the sun do not fall directly on chlorine containers.

Natural ventilation may be adequate for a small chlorinator installation in a separate building when windows and doors can provide cross circulation; however, ventilation by means of a proper type electric fan is always recommended.

In all cases, installations must comply with appropriate regulations.

5.2 HEALTH HAZARDS

Exposure to a sufficiently high concentration of chlorine can result in difficulty in breathing and, if prolonged, finally death through suffocation. Chlorine's strong pungent odor may result in detection at levels as low as 1.0 ppm and most people will detect it by the time the concentration reaches 3.5 ppm. Concentrations of 5 ppm or more are so objectionable that only those who are unconscious or trapped will normally remain in the area. Increasing concentrations will produce eye irritation, coughing, throat irritation, vomiting, and labored breathing.

Even concentrations below the threshold of smell can result in minor eye and throat irritation if the exposure is long enough.

Liquid chlorine can cause burns and/or irritation when it is in contact with the skin or eyes.

Medical attention should be obtained immediately for personnel who have sufficient exposure to result in any symptoms beyond minor irritation. Properly trained and equipped first aid personnel are usually the first line of defense. While waiting for their arrival, the exposed individual must be removed to a safe area and be placed in a comfortable position. If breathing has stopped, artificial respiration must be started immediately. CPR administered by properly trained personnel is required if the heart has stopped.

If the exposed individual has difficulty breathing, oxygen should be administered only by those adequately trained in the procedure and the equipment used.

The proper procedure for emergency treatment of clothing or skin contaminated by chlorine is to flush the area with large quantities of water under a shower for at least 15 minutes. While still under the shower, affected clothing should be removed. No medical treatment or neutralization of the chlorine should be attempted except as directed by a physician.

Immediate flushing with tepid water should be administered if even small quantities of chlorine enter the eye or if the eye has been exposed to strong concentrations of chlorine. The eyelids must be parted and thorough flushing continued for at least 15 minutes. As mentioned previously for skin exposure, no medical treatment or neutralization should be attempted except as directed by a physician.

The attending physician may wish to refer to a Material Safety Data Sheet on chlorine as well as to the Chlorine Institute's Chlorine Manual and/or Pamphlet 63, First Aid and Medical Management of Chlorine Exposures.

5.3 SAFETY PRECAUTIONS

The first steps to be taken in providing proper safety precautions at any facility are the selection of safety equipment to be on hand, the proper location of the equipment, and the training of all personnel in proper procedures to avoid unnecessary chlorine releases and to deal with releases that occur.

Proper respiratory equipment is essential for all facilities regardless of size. For maximum safety, it is preferable to use air tank type pressure demand masks that have a self-contained air supply and, therefore, are suitable regardless of chlorine concentration.

All respiratory equipment must meet the requirements of the National Institute for Occupational Safety and Health. Following the respiratory equipment manufacturer's recommendation regarding maintenance and periodic testing is essential. This equipment should be stored outside the area containing chlorine or chlorine equipment in a manner protecting it from damage of any kind and so as to be readily available.

WARNING: DO NOT LOCK CABINETS OR CLOSETS IN WHICH RESPIRATORY EQUIPMENT IS STORED, AS THE EQUIPMENT MUST BE READILY AVAILABLE.

All personnel with no assigned responsibility for dealing with a chlorine release should be instructed to leave the area. Those responsible for correcting the situation should don respiratory equipment before doing so.

Protective clothing is recommended for handling even routine operations involving chlorine. In the event of a substantial release, protective clothing is required. Anyone desiring further information on protective clothing should refer to the Chlorine Institute Pamphlet 65, Protective Clothing for Chlorine.

Safety shoes, hard hats, and safety glasses should be used in accordance with standard plant practice.

Most leaks will occur in piping, valves, connections, and the pressurized portions of chlorine equipment. These leaks will usually be eliminated by tightening packing, replacing gaskets, or repairing the equipment.

WARNING: REPLACE FLEXIBLE CONNECTIONS ANNUALLY, OR SOONER IF THERE IS EVIDENCE OF DETERIORATION.

Emergency kits (meeting Chlorine Institute requirements) are available that can seal off most leaking areas of chlorine

containers (i.e., valves, fusible plugs, or container wall). If these are on hand they must be used only by personnel thoroughly familiar with their use. The chlorine supplier should be contacted immediately for information, assistance, and advice on the disposition of the leaking container. The container should always be repositioned, if possible, so the leak is gas rather than liquid.

WARNING: NEVER UNDER ANY CIRCUMSTANCE SPRAY WATER ON A CHLORINE LEAK. THIS WILL ONLY MAKE IT WORSE.

Wall charts are available from most chlorine suppliers that provide much of the information contained in this manual.

5.4 EMERGENCY ACTION PLANS

The best emergency plan includes routine practices that are designed to minimize emergencies. Proper maintenance of all equipment associated with the storage, handling, and use of chlorine in accordance with the manufacturer's instructions is essential.

All equipment and piping containing chlorine under pressure must be tested periodically for leaks following procedures covered in Paragraph 4.8. Since it is not unusual for areas used for chlorine storage and chlorine equipment to be relatively unattended, it is important for the air in these areas to be monitored continuously with chlorine detectors, so that warning of leaks is given as early as possible. As with most emergencies, the earliest detection helps to minimize the damage to equipment and personnel. In addition to warning of leaks when the areas are unattended, chlorine detectors should warn of the presence of minor amounts of chlorine that may not be detected by personnel in the area.

Some chlorine leaks are minor but all require immediate attention.

In the event of a major release of chlorine, there should be no delay in contacting the agency in the community that is responsible for handling hazardous material releases. Appropriate names and telephone numbers must be prominently posted.

The chlorine supplier is probably the best source of assistance for most chlorine users. In addition, the Chlorine Institute's Chlorine Emergency Plan (CHLOREP) can provide vital assistance. In the United States this plan is activated through CHEMTREC (toll free 800-4249300). In Canada, contact CANUTEC (call collect 613-996-6666). These names and numbers must also be posted prominently.

The person responsible for making any of the calls listed above must be sure to give the agency contacted complete details including facility name, address, telephone number, and the names(s) of personnel to contact for further information. The description of the emergency should include size of container, corrective action already taken, local weather conditions, injuries, proximity to populated areas, and directions for easiest access to the site.

It is vital that the emergency plan include use of the "buddy system", i.e., no personnel should be allowed to work alone in an area with a chlorine leak even if the second person is only standing by. As indicated earlier, all personnel not involved in locating and correcting the leak should leave the area travelling in a crosswind direction to an area that is upwind and above the leak. Since it may not be possible for all personnel to be equipped with respiratory equipment, they should be instructed to use a wet cloth or handkerchief over the nose and mouth while leaving the area.

Chlorine Institute Pamphlet 64, Emergency Control Planning Checklist for Chlorine Facilities, may be of assistance in preparing the emergency plan. A Material Safety Data Sheet for Chlorine, available from the Institute or the supplier, should also be consulted.

No emergency plan should be implemented until it is reviewed by the chlorine supplier and the agency in the community having responsibility for hazardous material handling and disposal.

If it is apparent that fire will threaten or is present in a chlorine storage area, it is preferable to remove the containers. If this is not possible, the containers must be protected from the heat of the fire by spraying them with water. Do not spray water on any leaking container, however, since water will react with the chlorine, forming acids that will make the leak worse.

5.5 CHEMICAL DISPOSAL FACILITIES

Part of the planning for emergencies entails provision for disposal of any released chlorine. In most cases little can be done about the chlorine already released to the atmosphere except to try to prevent its dissipation into areas where damage to equipment and personnel will result.

At some large installations, scrubbers have been installed so that areas containing chlorine or chlorine equipment can be sealed off and the air removed to a process that will absorb the chlorine. The design of such a system is complex and should only be attempted by those thoroughly familiar with the process.

Absorption systems have been provided at some facilities to permit a leaking container to be emptied quickly if this is deemed essential. One pound of chlorine can be absorbed by 1.4 pounds of sodium hydroxide (caustic soda), 3.7 pounds of sodium carbonate (soda ash), or 1.3 pounds of calcium hydroxide (hydrated lime).

WARNING: TO AVOID SEVERE PERSONAL INJURY WHEN USING CORROSIVE CHEMICALS, OBSERVE ALL SAFETY PRECAUTIONS RECOMMENDED BY THE CHEMICAL MANUFACTURER/ SUPPLIER.

In each case, one pound of the material should be dissolved in one gallon of water. Lime will actually be suspended in, rather than dissolved in, the water and requires constant agitation.

The tank and other equipment provided for an absorption system must be fabricated of materials suitable for the chemicals involved.

Provision must be made for dissolving the chlorine in the alkaline solution in such a way that the solution cannot be sucked back into the container.

Actually the safest way of disposing of the chlorine in the leaking container might be through the chlorination process, particularly if the process can absorb the chlorine at higher than normal rates without creating damage.

It is not generally permissible to ship a container damaged by leak or fire if it contains chlorine. If for some reason this seems necessary, the chlorine supplier must be contacted.