Wallace & Tiernan®

an evoqua brand

SERIES V-2000 CHLORINATOR

10,000 Lb/24 Hr Automatic Control

BOOK NO. WT.025.055.006.UA.IM.0714

W3T109602

SERIES V-2000
CHLORINATOR

10,000 LB/24 HR
AUTOMATIC CONTROL

BOOK NO. IM WT.025.055.006.UA.IM.0714

W3T109602

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

INTRODUCTION

This instruction book provides installation, operation and maintenance instructions for the Evoqua Water Technologies Series V-2000 Gas Feeder (Chlorine). Of necessity, more information is included than applies to each specific installation; disregard those details that do not apply to your installation.

WARNING: DO NOT USE THIS EQUIPMENT FOR SWIMMING POOL, WATER PARK OR SIMILAR RECREATIONAL APPLICATIONS. IT IS NOT SOLD FOR SUCH USE.

The complete gas feeder consists of a control module, an injector, and a vacuum regulator. The vacuum regulator and accessories are covered in separate books provided with each piece of equipment.

The Series V-2000 Gas Feeder is designed to meter and control the flow of chlorine gas. An injector accepts this flow of gas, mixes it with water, and delivers the resultant solution to the point of application. By using a selection of rotameters and valve seats, the gas feeder may be adapted to meet a wide range of capacity requirements. Thus, as requirements change over a period of time, the capacity of the gas feeder may be changed accordingly. A large indicator scale on the rotameter permits a direct reading of the rate of gas feed in pounds per 24 hours. Control of the feed rate is electric; however, a simple release mechanism permits the operator to assume manual control at any time.

The gas feeder is equipped with a three- or four-inch variable throat injector, except for capacities of less than 3000 lb/24 hr, where a two-inch variable throat injector might be used.

WARNING: HAZARDOUS GAS IS PRESENT IN THIS EQUIPMENT DURING NORMAL OPERATION. TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT, READ THIS INSTRUCTION BOOK AND THE APPROPRIATE GAS MANUAL BEFORE CONNECTING THIS EQUIPMENT TO A SUPPLY OF GAS. OPERATION AND MAINTENANCE OF THIS EQUIPMENT MUST BE RESTRICTED TO TRAINED, QUALIFIED PERSONNEL WHO ARE COMPLETELY FAMILIAR WITH THESE INSTRUCTIONS. CONSULT FACTORY FOR APPLICATIONS AGAINST A NEGATIVE HEAD (PARTIAL VACUUM) OR A POSITIVE BACKPRESSURE OF LESS THAN 1.0 PSI (28 INCHES OF WATER) IN THE SOLUTION DISCHARGE LINE.

TABLE OF CONTENTS

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

VERY IMPORTANT SAFETY PRECAUTIONS - CHLORINE

This and the following page titled “Very Important Safety Precautions” provide, in brief, information of urgent importance relative to safety in the 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 MUCH 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.

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 COMMERCIALLY AVAILABLE PARTS AS IDENTIFIED BY COMPLETE DESCRIPTION ON PARTS LIST. THE USE OF UNLISTED PARTS CAN RESULT IN EQUIPMENT MALFUNCTIONS CAUSING POSSIBLE SEVERE PERSONAL INJURY.

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

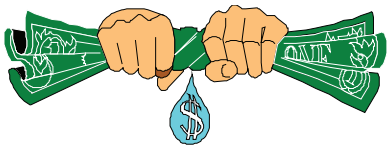
ADDITIONAL OR REPLACEMENT COPIES OF THIS INSTRUCTION BOOK ARE AVAILABLE FROM:

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.



PROTECT YOUR EQUIPMENT INVESTMENT

MINIMIZE DOWNTIME

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

Quality Equipment	**+**	**Preventive Maintenance**	**=**	**Dependable Operation Minimum Downtime**

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.

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

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 Itee
505 Levy Street
St. Laurent, Quebec
H4R 2N9
(450) 582-4266

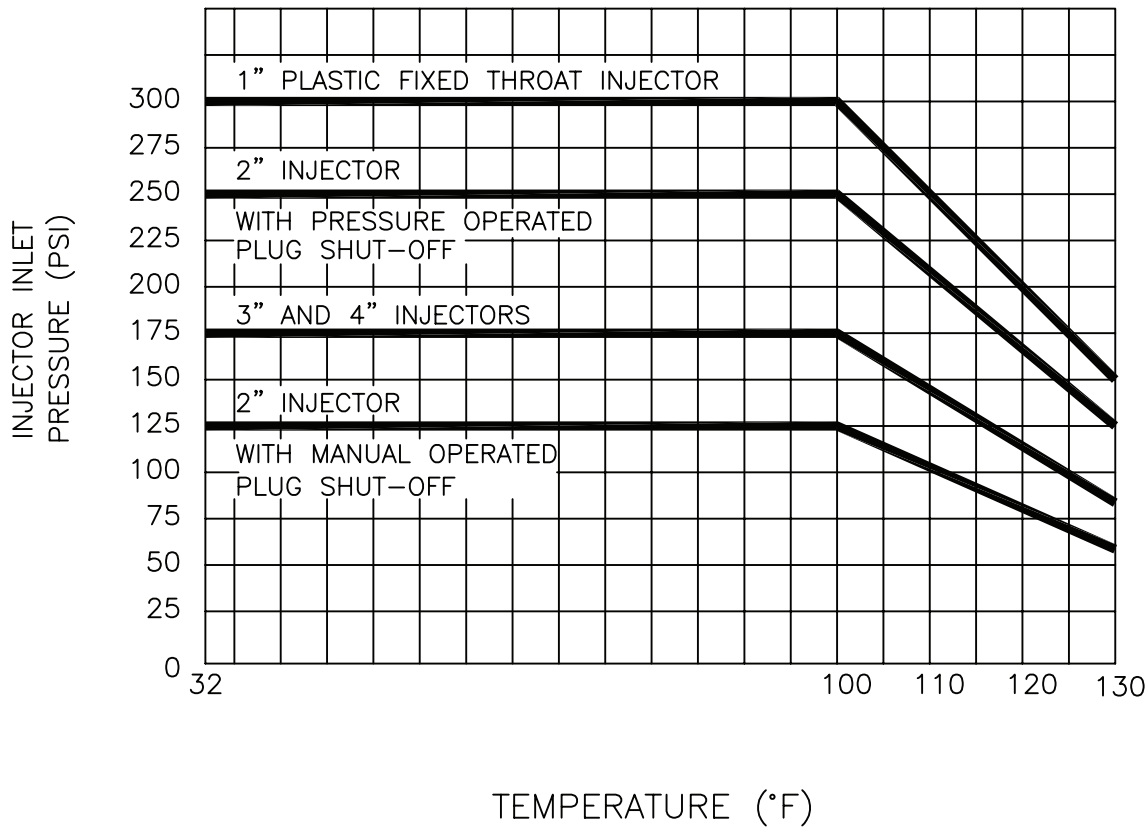
SECTION 1

SECTION 1 - TECHNICAL DATA

List Of Contents

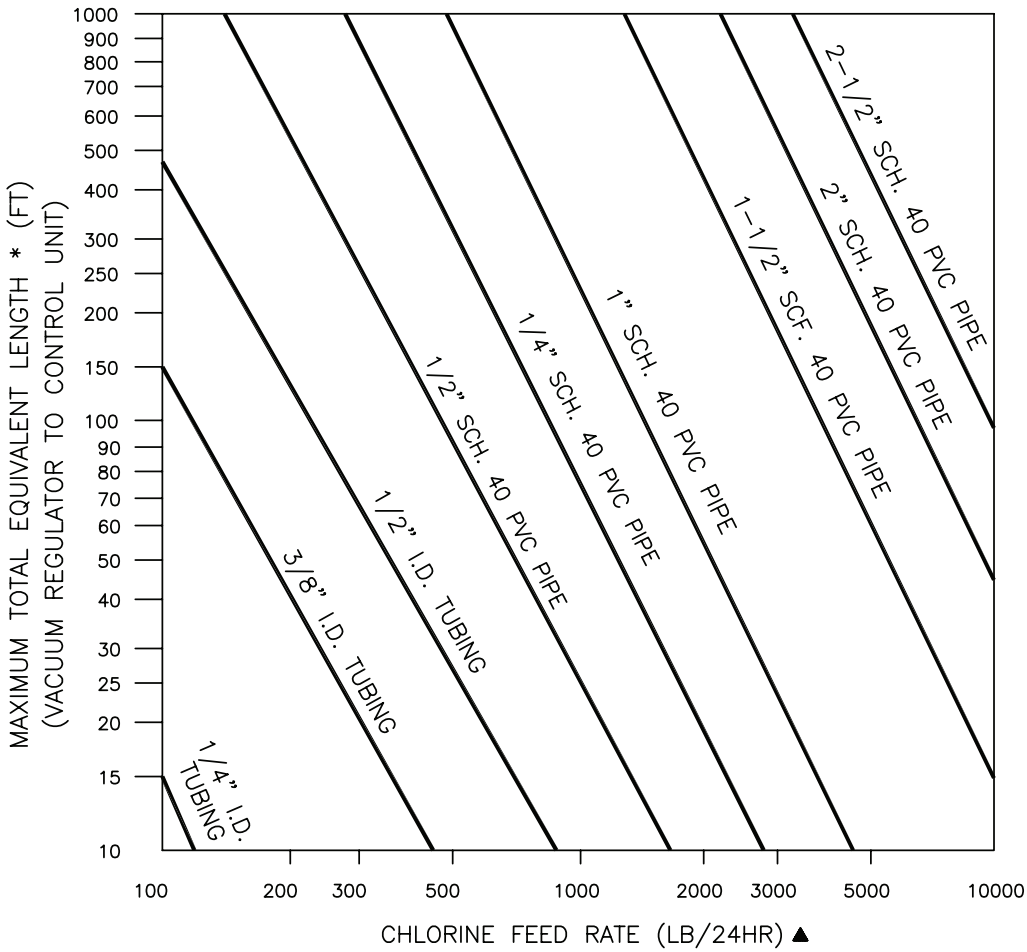
1.1 Technical Data

Accuracy	4% of indicated flow
Capacity	1,000 to 10,000 lb/24 hr chlorine
Feed Range	10 to 1 for any one V-notch plug
Pressure at Point of Application	75 psi max. with flexible polyethylene for the solution line. 160 psi max. with high pressure hose or rigid pipe for the solution line.
Minimum Injector Inlet Pressure	20 psi required by two-inch pressure operated plug shut-off injector.
Maximum Injector Inlet Pressure	See drawing 25.055.190.010



V-2000 INJECTOR INLET PRESSURE LIMITS
- PERFORMANCE

25.055.190.010
ISSUE 2 7-05



APPROXIMATE FRICTION LOSS IN PVC PIPE
FITTING IN EQUIVALENT FEET OF PIPE:

NOMINAL PIPE SIZE, IN.	1/2	3/4	1	1-1/2	2	2-1/2
TEE, SIDE OUTLET	4	5	6	8	12	15
90° ELBOW	1-1/2	2	2-3/4	4	6	8
45° ELBOW	3/4	1	1-3/8	2	2-1/2	3

NOTE:

* TOTAL EQUIVALENT LENGTH = PIPE LENGTH PLUS EQUIVALENT LENGTH FOR EACH FITTING. SEE TABLE ABOVE. 1.) WITH AUTOMATIC SWITCHOVER VACUUM REGULATORS, USE THE LENGTH OF THE LONGER OF THE TWO VACUUM LINES, NOT BOTH, TO DETERMINE TOTAL LENGTH. 2.) TO KEEP THE PRESSURE LOSS WITHIN PERMISSIBLE LIMITS, A COMBINATION OF PIPE SIZES MAY BE USED. IF THIS IS DONE, FOR A GIVEN FLOW, THE LOSS THROUGH EACH FOOT OF 1/2" SCH. 40 PVC PIPE IS EQUIVALENT TO THE LOSS THROUGH : A.) 3FT. OF 3/4" SCH. 40 PVC PIPE; B.) 8 FT. OF 1" SCH. 40 PVC PIPE; C.) 45FT. OF 1-1/2" SCH. 40 PVC PIPE; D.) 122 FT. OF 2" SCH. 40 PVC PIPE; E.) 248 FT. OF 2-1/2" SCH. 40 PVC PIPE.

▲ FOR GASES OTHER THAN CHLORINE, USE THE FOLLOWING APPROXIMATE CONVERSIONS:
CHLORINE FEED RATE = SULFUR DIOXIDE FEED RATE (LB/24HR.)
= 2.1 X AMMONIA FEED RATE (LB/24HR.)
= 1.3 X CARBON DIOXIDE FEED RATE (LB/24HR.)

VACUUM LINE LENGTH LIMITS - PERFORMANCE
Used In Remote Vacuum Gas Feeders

25.052.190.030
ISSUE 3 5-97

SECTION 2

SECTION 2 - INSTALLATION

List Of Contents

WARNING: THIS CONTROL MODULE IS DESIGNED TO OPERATE UNDER VACUUM ONLY. TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, DO NOT CONNECT TO A SOURCE OF GAS UNDER PRESSURE.

2.1 Location of Components

The general physical requirements of the installation are shown on the Typical Installation drawings. Locate the control module so that the vent may be run as described below and the necessary gas and power supplies may be connected. Ready access to the equipment for operation, routine maintenance, and service is required. Locate the injector so that the water supply, solution line to the point of application, and suction lines may be connected with access for service conveniently provided.

2.2 Gas Supply

For gas supply installation details, refer to the separate instruction book provided with the vacuum regulator-check unit (which regulates the gas supply to the control module).

2.3 Unpacking

When the equipment and accessory items are unpacked, check all items against the packing list to be sure that no parts are discarded with the packing material. Whenever possible, unpack the equipment at the installation site. Set aside items, such as spare parts, not required at the time of installation where they will be available when needed.

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, DO NOT DISCARD THIS INSTRUCTION BOOK UPON COMPLETION OF INSTALLATION. INFORMATION PROVIDED IS ESSENTIAL TO PROPER AND SAFE OPERATION AND MAINTENANCE.

CAUTION: To prevent damage to the module, replace the shim washers underneath the module after the plywood base is removed.

2.4 Rotameter

For protection in shipment, the rotameter and associated parts are removed after the gas feeder is factory tested. These parts are separately packaged; assemble and install as indicated on Drawing 25.055.150.020.

2.5 Vent

A vent line is required from the pressure relief port on the vacuum regulator-check unit to a point outside the building where an occasional gas leak will not be objectionable. The proper installation of this line is extremely important. Refer to the instruction book provided with the vacuum regulator-check unit.

2.6 Electrical Connections

If the control module is furnished with built-in accessories requiring a power supply or wiring to other equipment, appropriate wiring diagrams will be found in the instructions for the accessory items.

NOTE: Field wiring must conform to local electrical codes.

2.7 Injector Suction Connection

A line must be provided to carry the gas from the module to the injector. The piping must be sized as required to obtain six inches of mercury minimum vacuum at the module (nine inches for 10,000 lb/24 hr model).

2.8 Injector Water Supply

The injector requires a supply of reasonably clean water. Equip water lines up to and including two-inch sizes with strainers. The pressure and quantity of water required varies from one installation to another and must be calculated for each individual application.

2.9 Drain

Two-inch bellofram-type injectors used for start-stop operation require a 1/4-inch ID drain hose to dispose of a short spurt of water when the injector is operated. Run the drain hose to a suitable floor drain or waste pipe.

A floor drain is required for the drain relief valve. Also, a floor drain is always desirable to facilitate injector service.

2.10 Injector Discharge

For three- or four-inch injectors, rubber- or saran-lined steel pipe is normally used. The pipe size varies with the injector used, the length of the solution line, and the capacity of the gas feeder. Elbows, tees, or Saunders valves should not be connected directly to the flanged solution discharge connection because they will affect the hydraulic performance of the injector. A length of straight pipe at least six diameters (18 to 24 inches) long should be used.

2.11 Point of Application

2.11.1 Main Connection

If the solution is to be applied in a main, a suitable pipe tap is required in the main to accommodate the solution tube or diffuser.

2.11.2 Open Well

If the solution is to be applied in a basin, flume, channel, etc., where there is no pressure, the line from the injector must be supported so that the open end is submerged to the bottom of the chamber or a minimum of six feet, if possible. Locate in a nonstagnant area.

2.12 Vacuum Regulator-Check Unit

CAUTION: The vacuum regulator-check unit (which is a gas pressure reducing valve, pressure check valve, and pressure relief valve, all-in-one) must be connected to the control module inlet. Refer to the separate instruction book supplied with the unit for installation instructions.

NOTE: The vacuum line extending from the vacuum regulator-check unit to the control module must not exceed the distance as determined through the use of the graph shown on Drawing 25.052.190.030 for the pipe sizes given. If necessary, any size tubing or pipe of suitable material can be installed that will give not more than five inches of water differential between the module and the vacuum regulator-check unit at maximum feed rate. Note that the equivalent length of any fittings must be added to the pipe length to obtain the total equivalent length as shown on the graph.

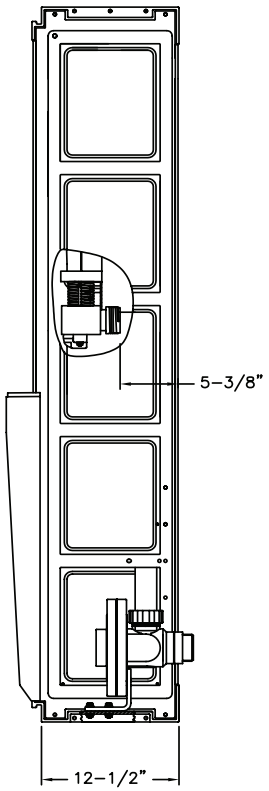
2.13 Injector Arrangements for Intermittent Start-Stop Operation

If the gas feeder is to be operated intermittently in conjunction with a pump or other equipment, this is usually accomplished by one of the following:

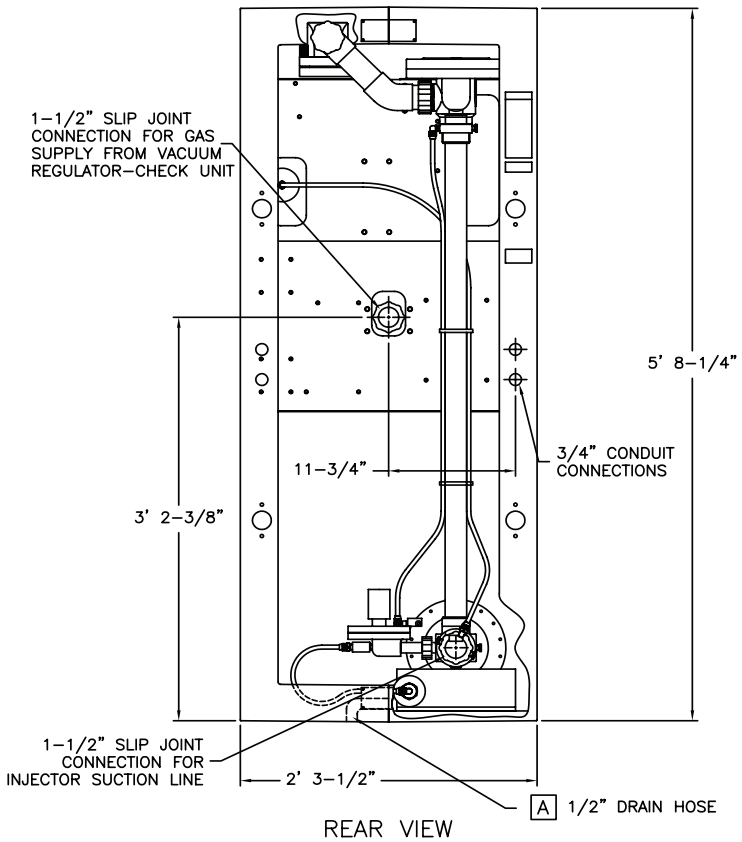
a. Injectors with three-way shut-off valves may be fitted with solenoid valves as shown in Drawings 25.100.006.122, 25.100.006.142, or 25.100.006.152. Material for this purpose is furnished only when specifically listed in the order.

b. Other injectors may be shut off by means of an electrically operated valve in the water supply line to the injector.

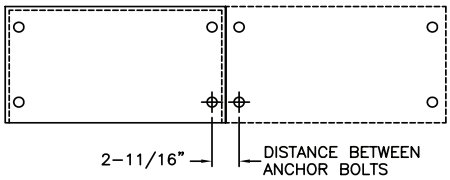
c. The gas flow may be stopped and started by means of an electrically operated PVC ball valve in the vacuum gas line from the module to the injector.

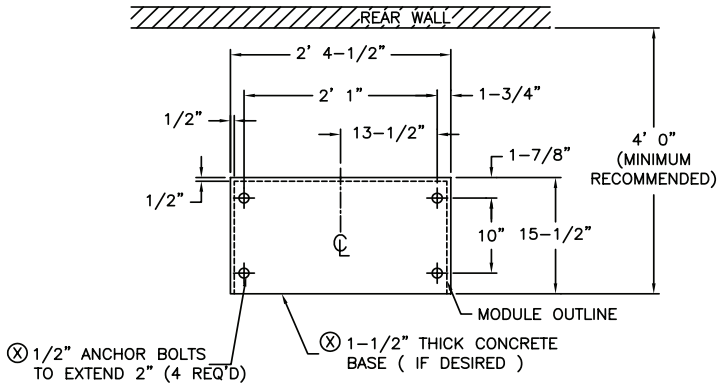


SIDE VIEW



REAR VIEW



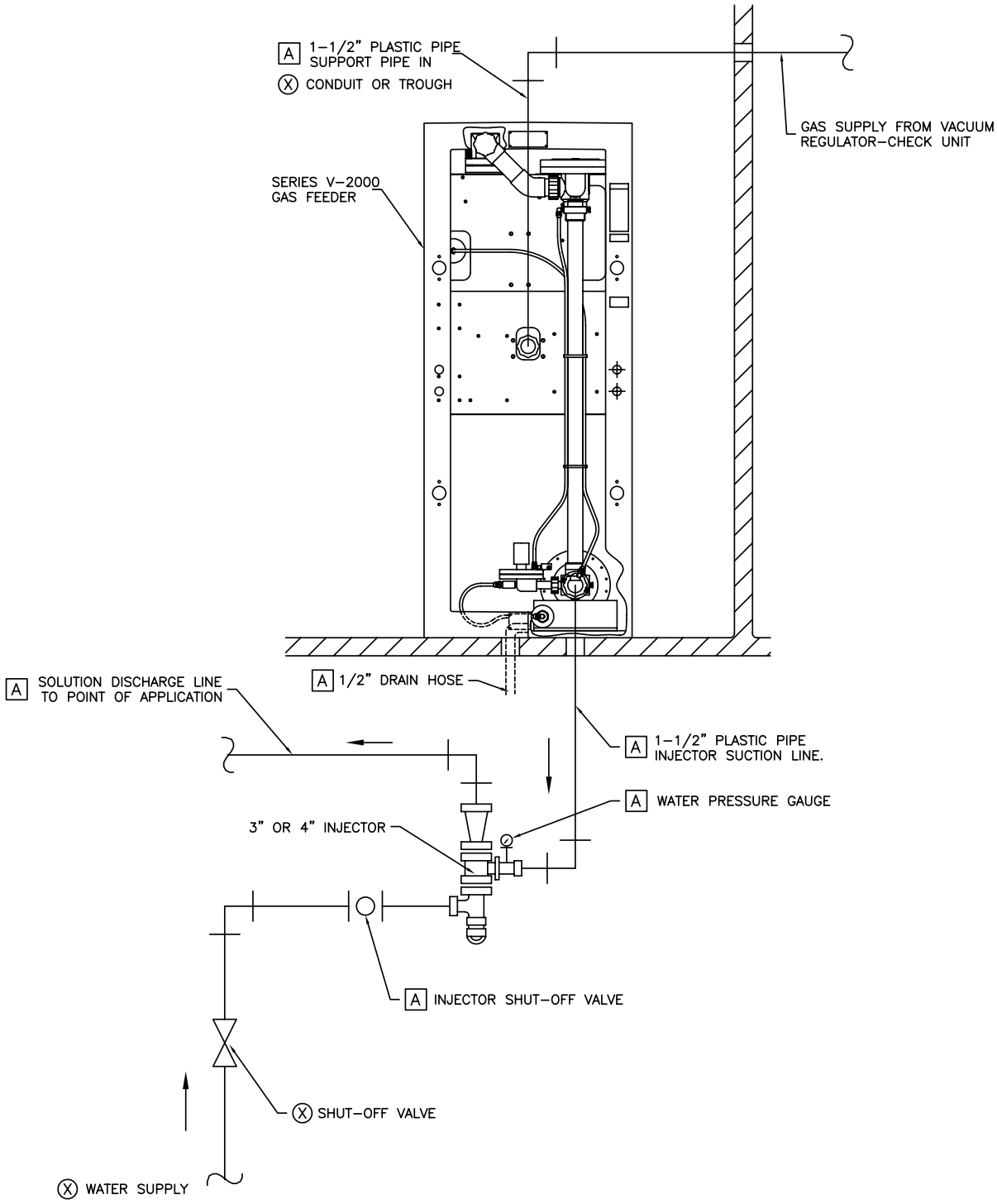


FLOOR PLAN FOR ONE OR MORE MODULES

NOTES: Ⓧ NOT FURNISHED BY EVOQUA WATER TECHNOLOGIES.
[A] ACCESSORY ITEM FURNISHED ONLY IF SPECIFICALLY LISTED IN QUOTATION.

SERIES V-2000 GAS FEEDER - DIMENSIONS

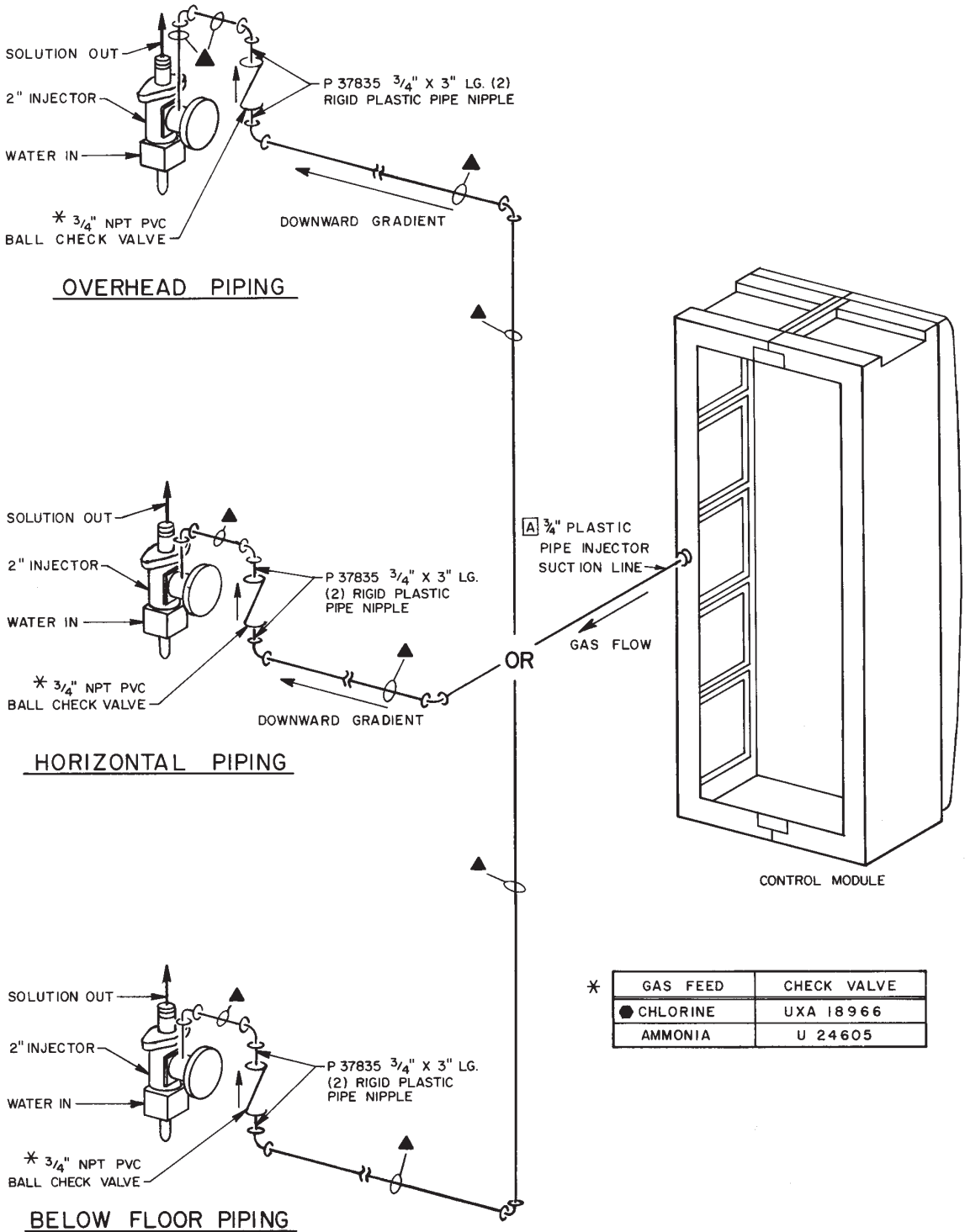
25.055.100.011
ISSUE 2 7-14



NOTES: X NOT FURNISHED BY EVOQUA WATER TECHNOLOGIES.
A ACCESSORY ITEM FURNISHED ONLY IF SPECIFICALLY LISTED IN QUOTATION.

SERIES V-2000 GAS FEEDER - TYIPICAL INSTALLATION

25.055.110.102
ISSUE 2 7-14



*

GAS FEED	CHECK VALVE
⬢ CHLORINE	UXA 18966
AMMONIA	U 24605

NOTE:
- ▲ HEIGHT AND LENGTH TO SUIT APPLICATION.
- ⬢ ALSO FOR SULFUR DIOXIDE AND CARBON DIOXIDE.
- ↑ CHECK VALVE ARROW INDICATES DIRECTION OF GAS FLOW.
- [A] ACCESSORY ITEM FURNISHED ONLY IF SPECIFICALLY LISTED IN QUOTATION.

2" INJECTOR WITH 3/4" BALL VALVE - TYPICAL INSTALLATION

25.055.110.075

ISSUE 0 4-87

TEMPERATURE AND PRESSURE: PVC PIPE IS NOT RECOMMENDED FOR TEMPERATURES OVER 130°F OR BELOW 0°F, NOR FOR LINES THAT MAY BE EXPOSED TO PHYSICAL ABUSE (SEE MANUFACTURER'S RECOMMENDATIONS). ONE HUNDRED FEET OF PIPE WILL EXPAND OR CONTRACT APPROXIMATELY 0.7 INCHES FOR EVERY 10°F TEMPERATURE CHANGE. MANUFACTURER'S RECOMMENDED MAXIMUM WORKING PRESSURES SHOULD NOT BE EXCEEDED.

SUPPORT AND PROTECTION: IT IS PREFERABLE TO SUPPORT HORIZONTAL OVERHEAD LINES WITH A CHANNEL OR ANGLE IRON PARALLEL TO THE PIPE. IF STRAP HANGERS ARE USED, SPACE THEM AT 2- TO 4-FOOT INTERVALS, AS RECOMMENDED BY THE PIPE MANUFACTURER. PIPE SHOULD NOT REST DIRECTLY ON RODS OR WIRES. PIPE MAY BE LAID UNDERGROUND WITH NO SPECIAL PRECAUTIONS OTHER THAN THOSE USED FOR IRON PIPE.

THREADING: SCHEDULE 80 PVC PIPE CAN BE CUT AND THREADED WITH STANDARD PIPE TOOLS, EITHER HAND OR POWER DRIVEN. STANDARD DIES COMMONLY USED FOR METAL PIPE WILL PRODUCE SATISFACTORY THREADS, THOUGH A 5° NEGATIVE RAKE ANGLE IS PREFERRED. KEEP DIES CLEAN AND SHARP AT ALL TIMES. DIES THAT HAVE BEEN USED EXTENSIVELY FOR STEEL PIPE MAY NOT PRODUCE GOOD THREADS UNLESS RESHARPENED. USE NORMAL CUTTING SPEEDS; NO LUBRICANT OR CUTTING OIL IS REQUIRED. A TAPERED PLUG (AVAILABLE FROM THE MANUFACTURER, IF DESIRED) TAPPED FIRMLY INTO THE END OF THE PIPE PREVENTS DISTORTION OF THE PIPE AND DIGGING-IN BY THE DIE, AS WELL AS CORRECTS ANY SLIGHT OUT-OF-ROUND THAT MAY EXIST. TAKE CARE TO CENTER THE DIE ON THE PIPE AND ALIGN THE THREAD TO PREVENT REDUCING THE WALL EXCESSIVELY ON ONE SIDE. SCHEDULE 40 PVC CANNOT BE THREADED.

THREADED JOINTS: THREADED JOINTS IN PVC PIPE REQUIRE MORE CARE THAN THOSE IN SIMILAR SIZE METAL PIPE. IF A NON-LUBRICATING THREAD COMPOUND IS USED, THE JOINT MAY FEEL TIGHT WHEN ONLY 2 OR 3 THREADS ARE ENGAGED. IF TEFLON TAPE OR SIMILAR LUBRICATING THREAD COMPOUND IS USED, THE JOINT MAY NOT FEEL TIGHT AT ALL, AND OVERTIGHTENING—RESULTING IN CRACKED FITTINGS OR STRIPPED THREADS—CAN EASILY OCCUR. CARE MUST BE TAKEN TO ENGAGE THE JOINED PARTS TO A NORMAL ENGAGEMENT OF 5 TO 7 TURNS AND NO MORE. STRAP WRENCHES ARE PREFERRED FOR ASSEMBLY, AS THE SHARP EDGES ON PIPE WRENCHES MAY SCORE AND WEAKEN THE PIPE.

FLANGED JOINTS: FOR FLANGED JOINTS, USE A FULL-FACED RUBBER GASKET AND FLAT WASHERS UNDER BOLTS AND NUTS. TIGHTEN OPPOSITE FLANGE BOLTS TO COMPRESS THE GASKET TO A SLIGHT DEGREE, BUT DO NOT DISTORT THE FLANGE.

SOLVENT WELD OR CEMENT JOINTS: ALWAYS USE CEMENT RECOMMENDED BY THE MANUFACTURER. ADD THINNER IF CEMENT THICKENS FROM EXPOSURE TO THE AIR.

1. CUT PIPE WITH ORDINARY HAND OR POWER SAW. MAKE A SQUARE CUT AND REMOVE BURRS.
2. CLEAN AND DRY OUTSIDE OF PIPE AND INSIDE OF FITTING.
3. APPLY A THIN COAT OF CEMENT TO INSIDE OF FITTING AND OUTSIDE OF PIPE. USE A NATURAL BRISTLE PAINT BRUSH. CEMENT TO BE WITHIN 1/4" BUT NOT CLOSER THAN 1/8" FROM END OF PIPE TO PREVENT INTERNAL BEAD FROM FORMING.
4. WHILE THE CEMENT IS STILL WET, STAB THE PIPE INTO THE FITTING AND GIVE 1/8 TURN.
5. AVOID ROUGH HANDLING FOR ONE HOUR. DEPENDING ON ATMOSPHERIC CONDITIONS, APPROXIMATELY 50% STRENGTH WILL BE ATTAINED IN 2 HOURS AND FULL STRENGTH IN 48 HOURS.

PIPE SIZE	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	3"	4"
JOINTS PER PINT OF CEMENT	50	50	35	35	25	25	16	12

CEMENT AVAILABLE FROM EVOQUA WATER TECHNOLOGIES IN PINT CANS (U24647). ALSO AVAILABLE COMMERCIALLY IN PINT, QUART AND GALLON CANS.

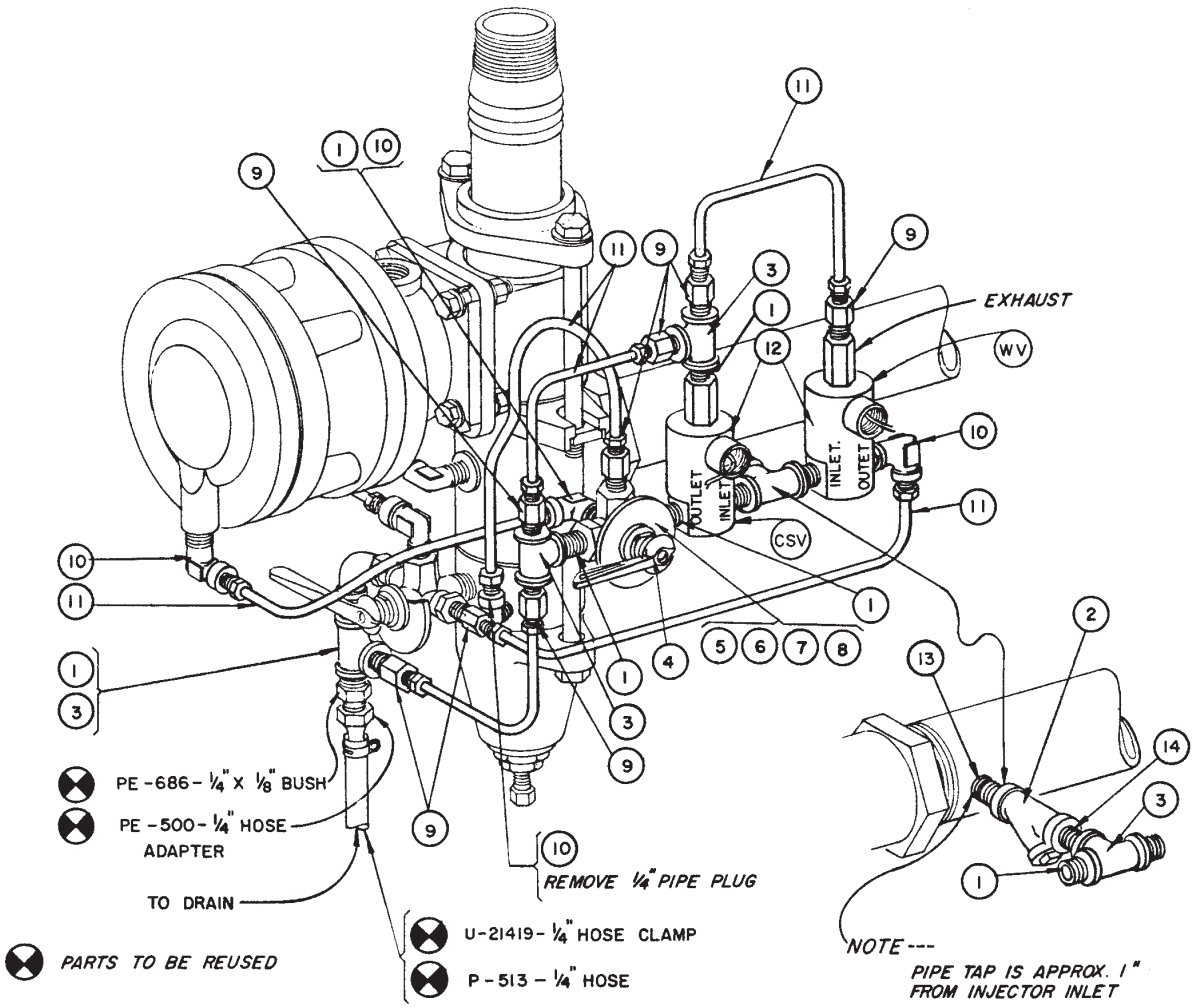
PVC PIPE - INSTALLATION
Fabrication and Installation

50.830.110.011
ISSUE 14 6-14

		PARTS LIST	
REF. NO.	PART NO.	DESCRIPTION	QUAN.
1	P-629	1/4" CLOSE PIPE NIPPLE	7
2	U-9967	3/8" "Y" TYPE STRAINER	1
3	P-695	1/4" PIPE TEE	4
4	U-16435	1/4" SELECTOR VALVE	1
5	P-40633	INDICATOR PLATE	1
6	PE-28283	MACH. SCREW (RD. HD., BRASS) #10-24 X 1/2" LG.	2
7	PE-5663	#10 WASHER	2
8	PE-14725	HEX. NUT (#10-24)	2
9	U-14710	1/4" PIPE X 1/4" TUBE HALF UNION	8
10	U-16096	1/4" PIPE X 1/4" TUBE HALF UNION ELBOW	4
11	RC59-4440	1/4" O D X .186" I D COPPER TUBING	6'-0"
* 12	U-19574	1/4" THREE WAY N.C. SOLENOID VALVE (115 V, 60 CYCLE)	2
13	P-1079	3/8" CLOSE PIPE NIPPLE	1
14	P-10917	3/8" X 1/4" PIPE REDUCING BUSHING	1

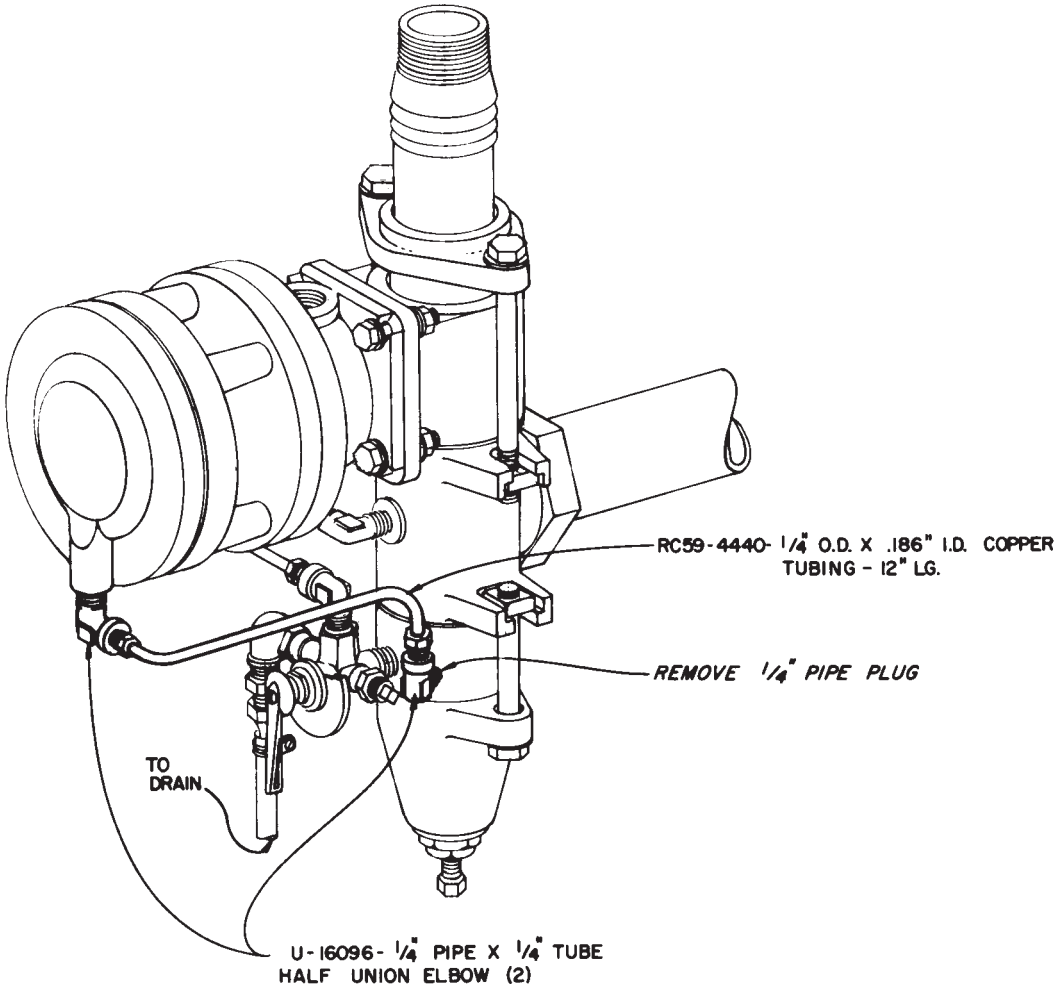
NOTE

** NOT INCLUDED IN G636*



2" INJECTOR - INSTALLATION PIPING
Connections for Prime and Flush Operation

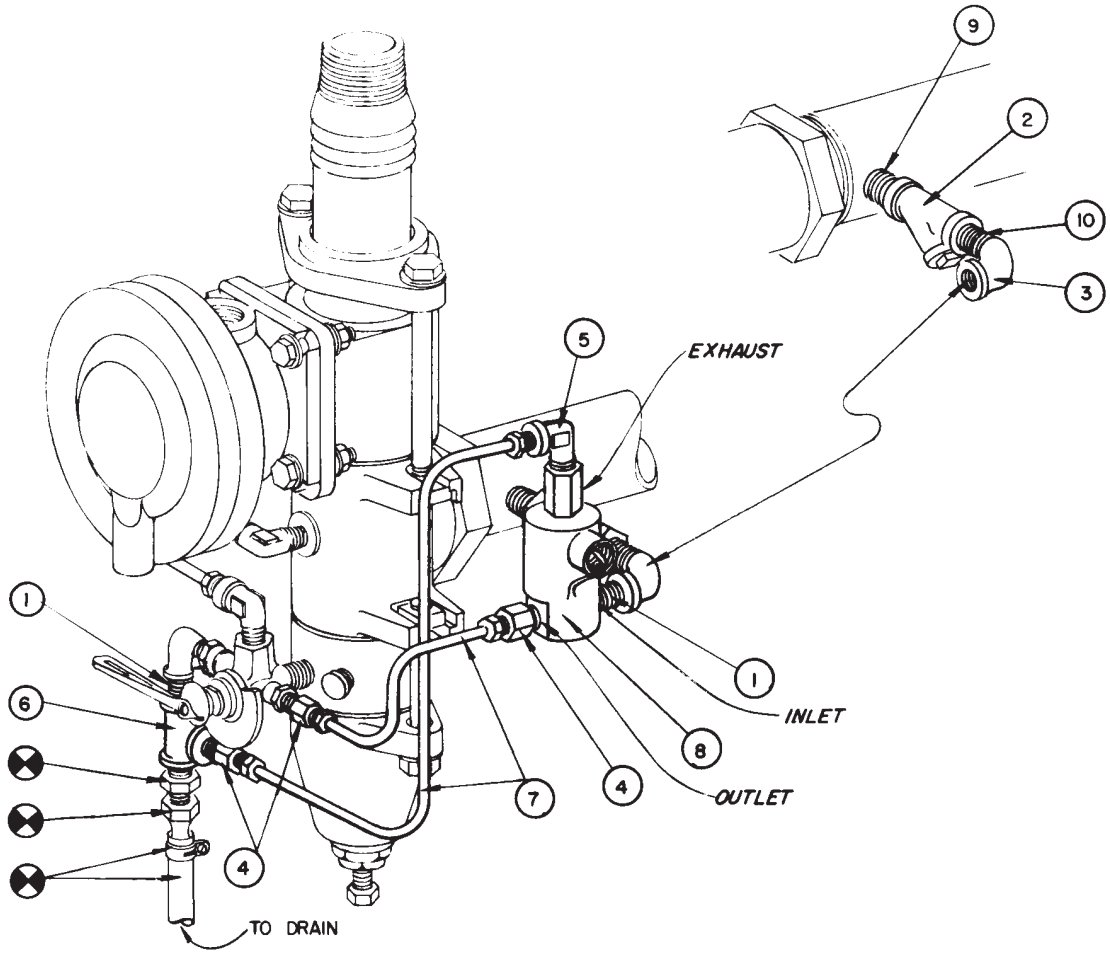
25.100.006.122
ISSUE 4 8-93



2" INJECTOR - INSTALLATION PIPING
Connections for Manual Suction Shut-Off Unit

25.100.06.131
ISSUE 3 1-90

PARTS LIST			
REF. NO.	PART NO.	DESCRIPTION	QUANT.
1	P 629	1/4" CLOSE PIPE NIPPLE	2
2	U 9967	3/8" "Y" TYPE STRAINER	1
3	P 698	1/4" STREET ELBOW	1
4	U 14710	1/4" PIPE x 1/4" TUBE HALF UNION	3
5	U 16096	1/4" PIPE x 1/4" TUBE HALF UNION ELBOW	1
6	P 695	1/4" TEE	1
7	RC59 4440	1/4" OD x .186" ID COPPER TUBING	3'-0"
✳ 8	U 19574	1/4" THREE WAY N.C. SOLENOID VALVE (115 VOLT, 60 CYCLE)	1
9	P 1079	3/8" CLOSE PIPE NIPPLE	1
10	P 10917	3/8" x 1/4" PIPE REDUCING BUSHING	1



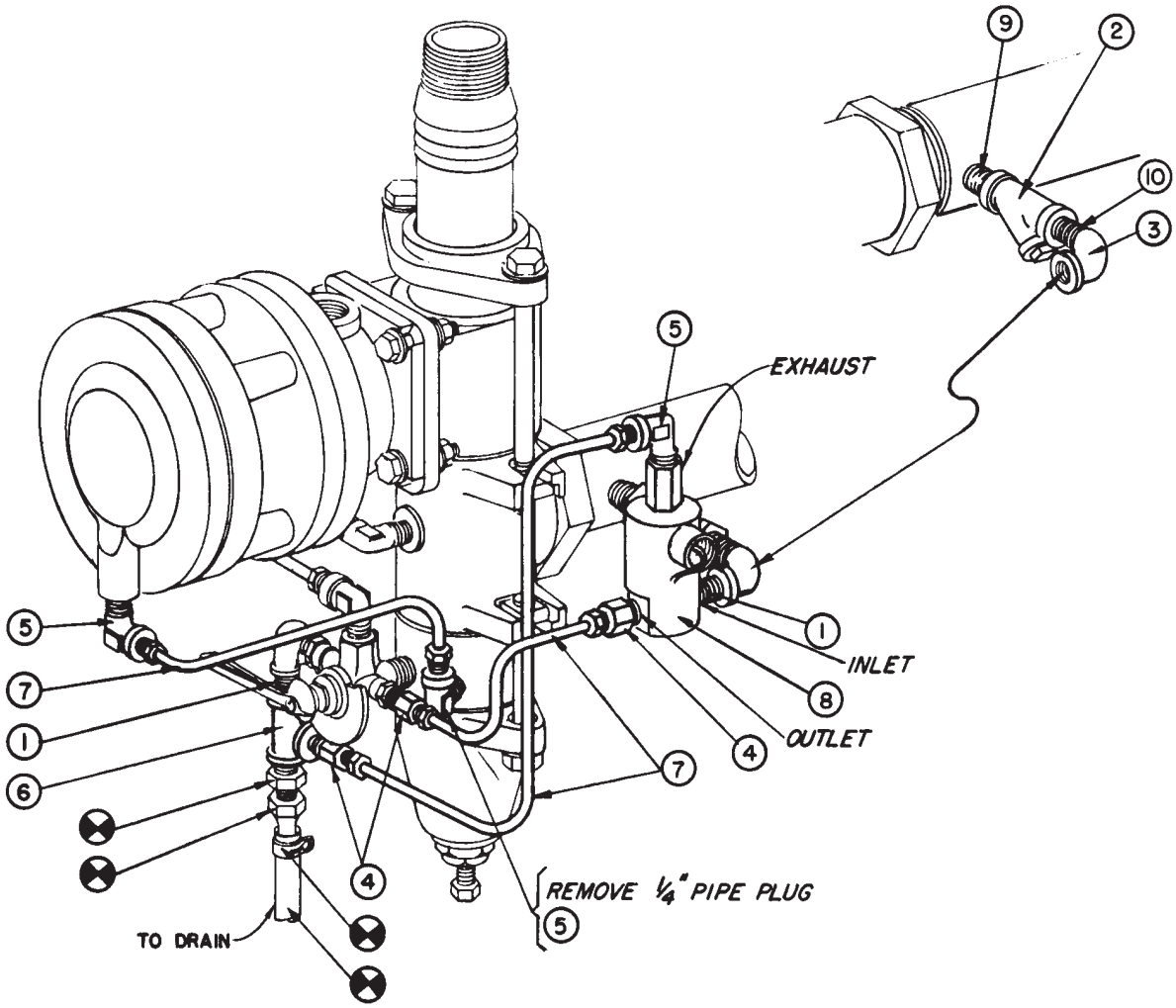
⊗ PARTS TO BE RELOCATED & REUSED

✳ NOT INCLUDED IN G634

2" INJECTOR - INSTALLATION PIPING
Connections for Intermittent Start-Stop Operation

25.100.006.142
ISSUE 2 4-93

PARTS LIST			
REF. NO	PART NO.	DESCRIPTION	QUANT.
1	P-629	1/4" CLOSE PIPE NIPPLE	2
2	U-9967	3/8" "Y" TYPE STRAINER	1
3	P-698	1/4" STREET ELBOW	1
4	U-14710	1/4" PIPE X 1/8" TUBE HALF UNION	3
5	U-16096	1/4" PIPE X 1/8" TUBE HALF UNION ELBOW	3
6	P-695	1/4" TEE	1
7	RC59-4440	1/4" O.D. X .186" I.D. COPPER TUBING	4'-0"
* 8	U-19574	1/4" THREE WAY N.C. SOLENOID VALVE (115 VOLT, 60 CYCLE)	1
9	P-1079	3/8" CLOSE PIPENIPPLE	1
10	P-10917	3/8" X 1/4" PIPE REDUCING BUSHING	1



⊗ PARTS TO BE RELOCATED & REUSED

* NOT INCLUDED IN G635

2" INJECTOR - INSTALLATION PIPING
Connections for Intermittent Start-Stop Operation
With Injector Suction Shut-Off Unit

25.100.006.152
ISSUE 2 8-92

SECTION 3

SECTION 3 - OPERATION

List Of Contents

3.1 Preparation for Operation

WARNING: HAZARDOUS GAS IS PRESENT IN THIS EQUIPMENT DURING NORMAL OPERATION. TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT, READ THIS INSTRUCTION BOOK AND THE APPROPRIATE GAS MANUAL BEFORE CONNECTING THIS EQUIPMENT TO A SUPPLY OF GAS. OPERATION AND MAINTENANCE OF THIS EQUIPMENT MUST BE RESTRICTED TO TRAINED, QUALIFIED PERSONNEL WHO ARE COMPLETELY FAMILIAR WITH THESE INSTRUCTIONS.

NOTE: See Drawing 40.300.170.010 for instructions for manual operation.

When all connections specified under Section 2 - Installation have been made, check the gas feeder as follows:

a. If the point of application is in a main through a corporation cock or valve, the cock or valve must be open. Push in the solution tube, if furnished, until the end is in the center third of the main. In the case of large mains, the tube may be pushed in as far as it will go.

b. Turn the injector shut-off valve to the ON position. Any other valves in the injector water supply line must be opened. Proper injector action may be determined by observation of at least nine-inch vacuum on the injector vacuum gauge on the control module when the machine is operating at maximum capacity. If sufficient vacuum cannot be obtained, consult Section 4 - Service.

c. If proper injector operation is indicated, shut off the injector and test the gas supply line for leaks. Start at the source of gas supply and open valves in sequence. As the valve is opened, test each valve and connection for leaks by removing the stopper from the bottle of ammonia furnished and holding the open bottle near the point to be tested. A chlorine leak will produce a white vapor or cloud because of the reaction between chlorine and ammonia. If a leak is detected, immediately shut off the supply and turn on the injector. Correct the leak before further operation is attempted.

3.2 Operation

NOTE: The following procedure assumes all preparatory steps and leak tests have been completed.

3.2.1 Starting

a. Turn on the gas supply at the supply container valve and the vacuum regulator-check unit.

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, DO NOT OPEN THE GAS SUPPLY CONTAINER VALVE MORE THAN ONE COMPLETE TURN. THIS WILL PERMIT MAXIMUM DISCHARGE AND CAN ALSO BE TURNED OFF QUICKLY IN CASE OF A GAS LEAK.

b. Turn on the injector shut-off valve.

c. The feed rate will be regulated by the control device. Dosage adjustments permit matching the desired feed rate to the flow signal.

d. If a vibrating noise is heard, refer to Section 4 - Service for corrective action.

3.2.2 Stopping - For Short Periods

Turn off the injector shut-off valve.

3.2.3 Stopping - For Extended Periods

a. Turn off the gas supply at each gas supply container valve.

b. Operate the injector until the supply vacuum gauge reads over 60 inches of water, then turn off the vacuum regulator-check unit and continue injector operation for at least three minutes to remove all gas from the machine.

c. Turn off the injector shut-off valve.

3.2.4 Adjustment of Injector

Injectors may be adjusted by means of an adjusting screw or knob at the bottom of the injector. A vacuum of at least six inches of mercury (nine inches at 10,000 lb/24 hr) is required to obtain maximum feed. If the minimum vacuum cannot be obtained, check the actual hydraulic conditions against those specified on the order before attempting any service.

To adjust the injector for maximum suction power, start the gas feeder and set the feed rate at the maximum required. Turn the adjusting screw clockwise (up) or counterclockwise (down) until the highest vacuum is obtained. To adjust the injector for minimum water usage, start the gas feeder and set the feed rate at the maximum required. Screw in (up) on the adjusting screw until the vacuum is just over the minimum required.

3.2.5 Intermittent Start-Stop Operation

In some cases it is necessary to start and stop the gas feeder in synchronism with other equipment. A common situation is one where the gas feeder must operate when a water supply pump operates and must stop when the pump stops.

In this case, an electrically operated solenoid water valve is installed in the main injector water line. The valve is wired into the water supply pump motor circuit so it will operate to open the water supply to the injector when the pump is on and to shut off the water supply to the injector when the pump is off. In this manner, the gas feeder is prevented from delivering gas to the point of application unless the pump is operating.

3.3 Theory of Operation (See Drawing 25.055.180.021)

Evoqua Water Technologies V-notch Gas Feeders and accessories are designed to control and indicate the rate of flow of chlorine, to provide a simple means of manually setting the feed rate at any value within the range of the machine, to mix the gas with water, and to deliver the resultant solution to the point of application. This equipment operates in response to an external electric signal, but a simple release mechanism permits the operator to assume manual control at any time (see drawing. 40.300.170.010).

In the gas feeder described in this manual, the function of the injector is to produce a vacuum to draw gas from the control module and to mix this gas with the water flowing through the injector. Proper operation of the injector is dependent on the inlet pressure being sufficiently higher than the discharge pressure. The differential regulating valve throttles the injector vacuum to maintain a constant drop across the V-notch variable orifice. Thus the flow through the orifice is entirely a function of the size of the orifice as determined by the position of the V-notch plug as set by a positioner in response to an electrical signal.

Gas under pressure enters the vacuum regulator-check unit.

The vacuum regulator-check unit incorporates a low temperature alarm switch in the base of the pressure check valve. This switch, when connected to an alarm, will provide an indication of any liquid carry-over from the evaporator. If liquid is present in the vacuum regulator-check unit, the intense chilling that occurs as the liquid vaporizes (due to the pressure reduction occurring in the regulator) will cause the switch to activate the alarm and to close the motorized ball valve.

From the vacuum regulator-check unit, the gas passes to the control module through connecting pipes and then through a rotameter (feed rate indicator) causing the float to indicate the rate of flow on an easily read scale. The rate of flow is controlled by the position of the V-notch variable orifice, across which a constant differential at less than atmospheric pressure is maintained by the operation of the differential regulating valve. From the differential regulating valve, gas passes to a trimmer valve. The trimmer valve acts as an accessory to the differential regulating valve by trimming the high vacuum developed by the injector. The drain valve relieves any water that might leak past the ball check valve in the injector. An anti-flood check valve aids in this function by relieving any excess vacuum that would

otherwise prevent drain relief. From the trimmer valve, the gas passes to the injector where it is mixed with water and the resultant solution is discharged to the point of application.

3.3.1 Two-inch Injector Manual Operation (See Drawing 25.100.181.011)

- Application Against Pressure

  When the three-way valve is in the ON position, water flows from the injector inlet through a strainer (A) and the three-way valve (B) to the chamber (C). Pressure in the chamber (C) overcomes the force of the spring (D) and opens the plug (E) the distance determined by the setting of the adjuster screw (F), permitting water to flow through the injector. The flow of water through the injector creates a vacuum that pulls the diaphragm (G), which opens the seat (H) and permits gas to be drawn from the gas feeder.

  When the three-way valve is turned to the OFF position, pressure in the chamber (C) is relieved and a spurt of water passes through the OFF port in the three-way valve to waste. The spring (D) closes the plug (E) and, with no water flowing through the injector to create a vacuum, the spring (J) closes the seat (H) to prevent water on the injector discharge from backing up into the gas feeder.

- Application Against Negative Head

  If the injector described above was used where a negative head existed at the injector discharge, when the injector was shut down, this suction might act on the diaphragm (G) with sufficient force that the spring (J) could not close the seat (H), with the result that gas would be drawn from the gas feeder.

To prevent this, an injector suction shut-off unit is added to the injector. When the three-way valve is in the OFF position, this unit, by the force of the spring (K) through the diaphragm (L) and the attached linkage, exerts a pull on the diaphragm (G) and holds the seat (H) closed. When the three-way valve is in the ON position, pressure from the chamber (C) is transmitted to the diaphragm (L) and the injector operates as described above.

3.3.2 Two-Inch Injector Intermittent Start-Stop Operation (See Drawing 25.100.181.021)

When the injector is connected to operate in conjunction with a pump, a solenoid valve is added so that, when the three-way valve is in the START-STOP position, electrical operation of the solenoid performs the same function as manual operation of the three-way valve, as previously described. When the solenoid is energized, water passes from the injector water supply through the strainer (M) through the solenoid (N) and the three-way valve to the chamber (C). When the solenoid is deenergized, the water supply is cut off and the exhaust port is opened, permitting the pressure chamber (C) to be relieved to waste.

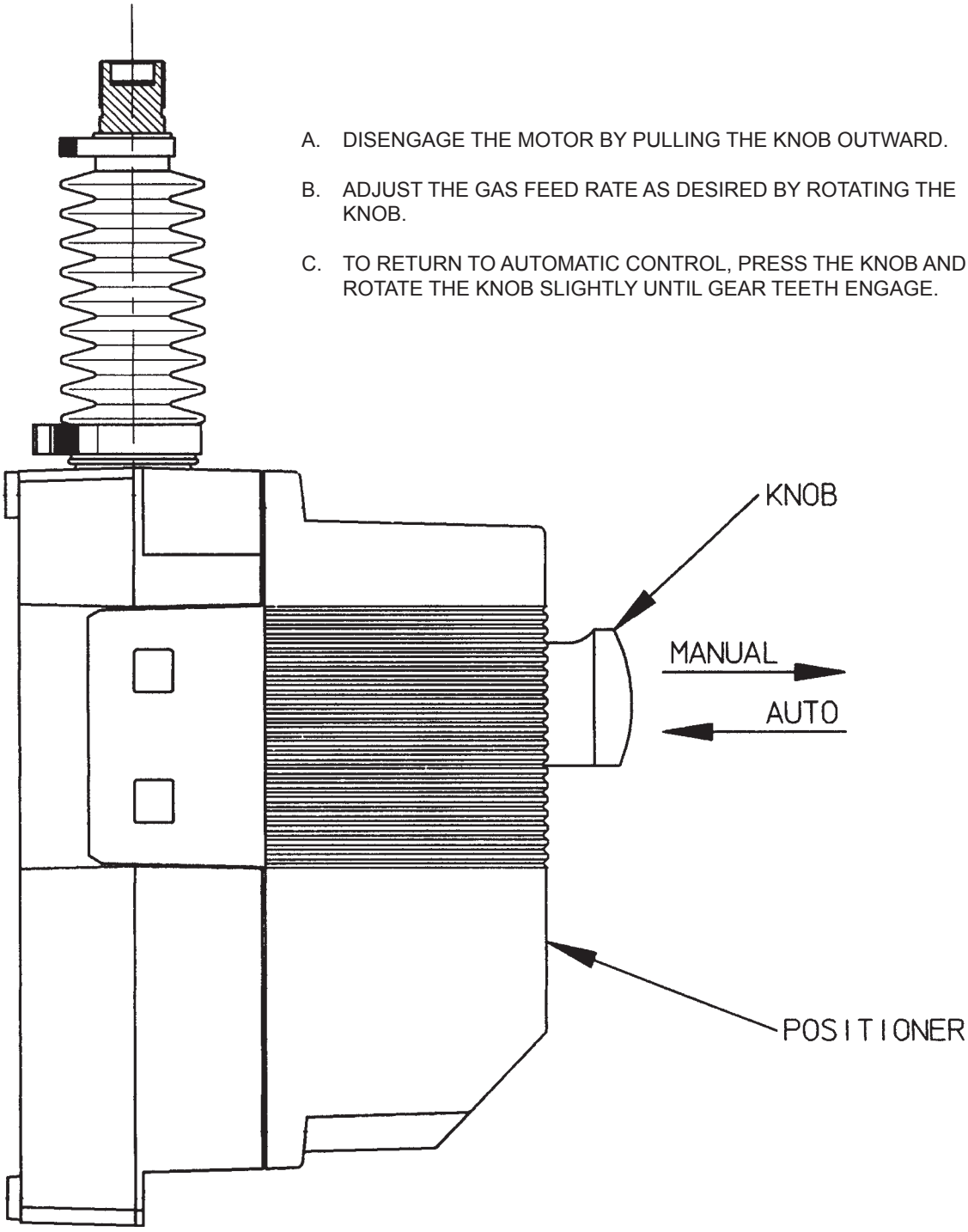
3.3.3 Two-inch Injector Prime and Flush Operation (See Drawing 25.100.181.031)

In an application such as the intermittent desliming process, it is desirable to run water through the system before and after chlorination. This is accomplished with a two-solenoid system. Operation is as follows: Both three-way valves are set in the START-STOP position. Energizing only the right-hand solenoid (WV) passes water to the chamber (C) causing the plug in the injector to open and water to flow through the injector for priming. The injector suction shut-off unit prevents the flow of gas until the chlorination period when the left-hand solenoid (CSV) is energized. At the end of the chlorination period, the left-hand solenoid is deenergized and the injector shut-off unit stops the flow of gas. Water continues to flow through the injector for flushing until the end of the cycle when the right-hand solenoid is deenergized. Operation of the solenoids is usually accomplished by a program clock in which each portion of the cycle may be fixed by setting adjustable cams.

A. DISENGAGE THE MOTOR BY PULLING THE KNOB OUTWARD.

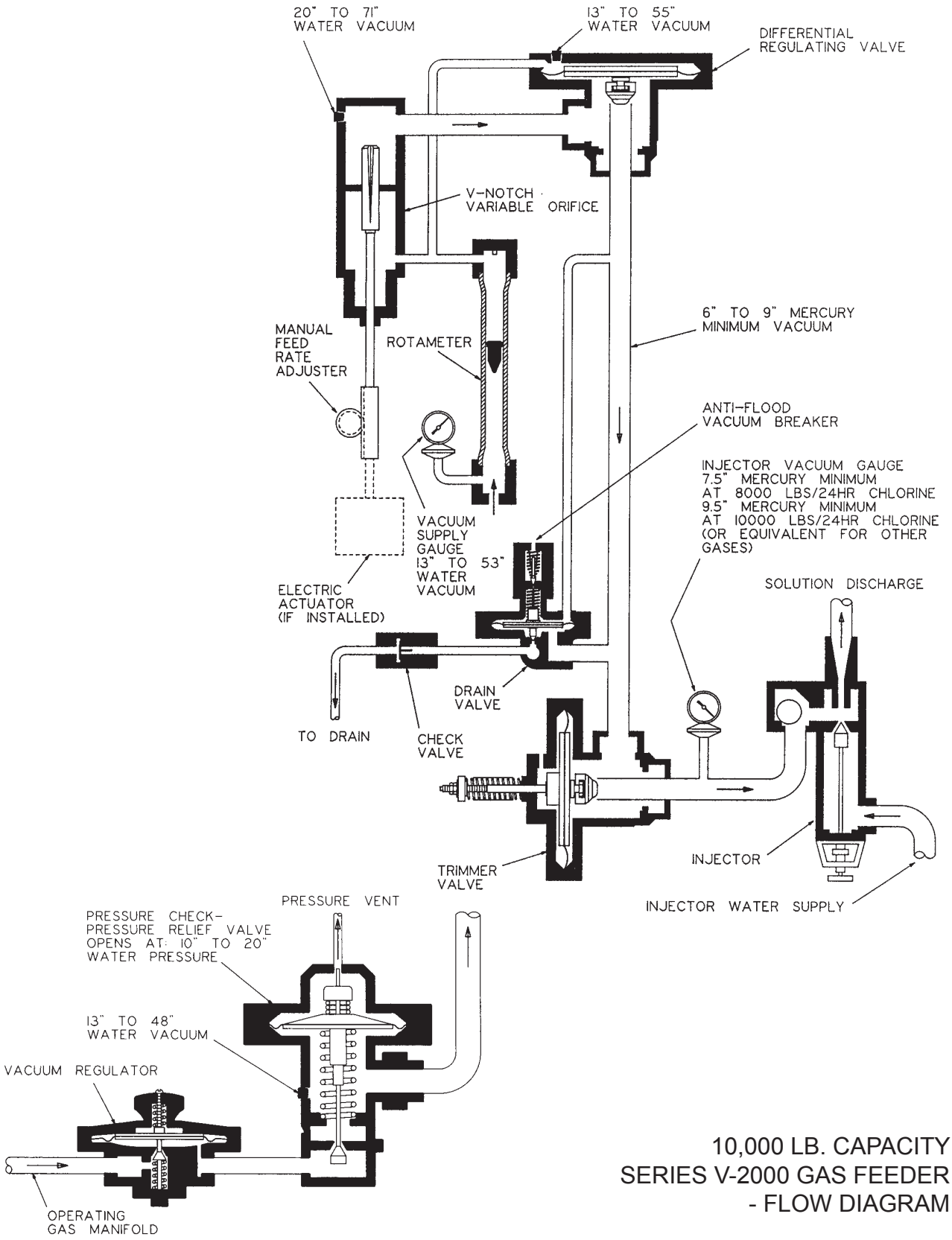
B. ADJUST THE GAS FEED RATE AS DESIRED BY ROTATING THE KNOB.

C. TO RETURN TO AUTOMATIC CONTROL, PRESS THE KNOB AND ROTATE THE KNOB SLIGHTLY UNTIL GEAR TEETH ENGAGE.



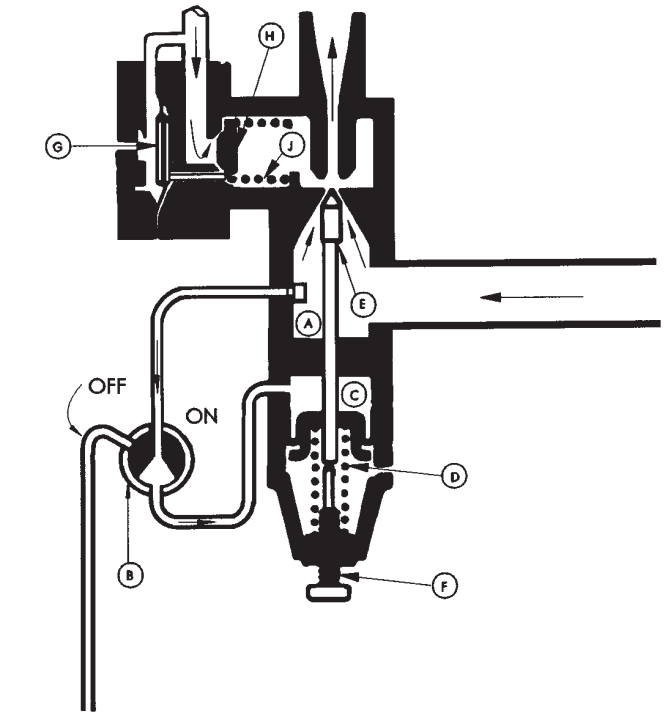
INSTRUCTIONS FOR MANUAL OPERATION - OPERATION
Positioner

40.300.170.010
ISSUE 0 10-95

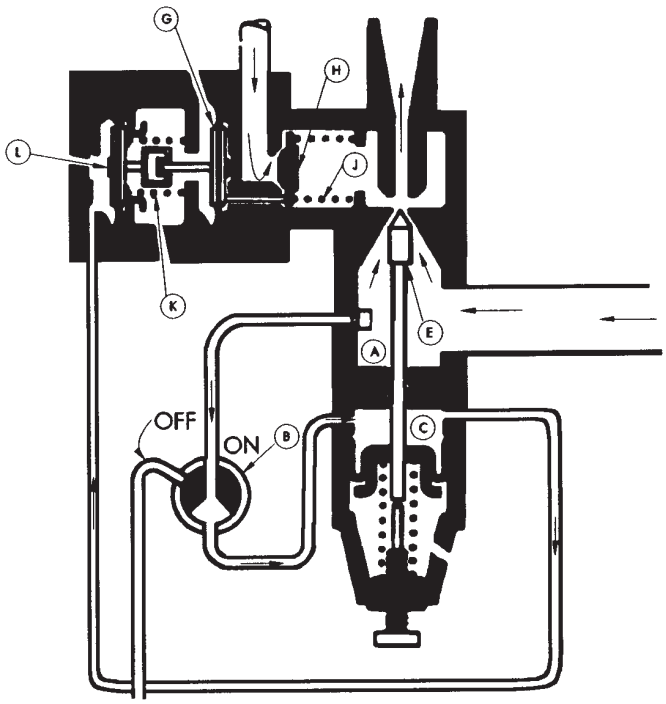


10,000 LB. CAPACITY
SERIES V-2000 GAS FEEDER
- FLOW DIAGRAM

25.055.180.021
ISSUE 1 10-93



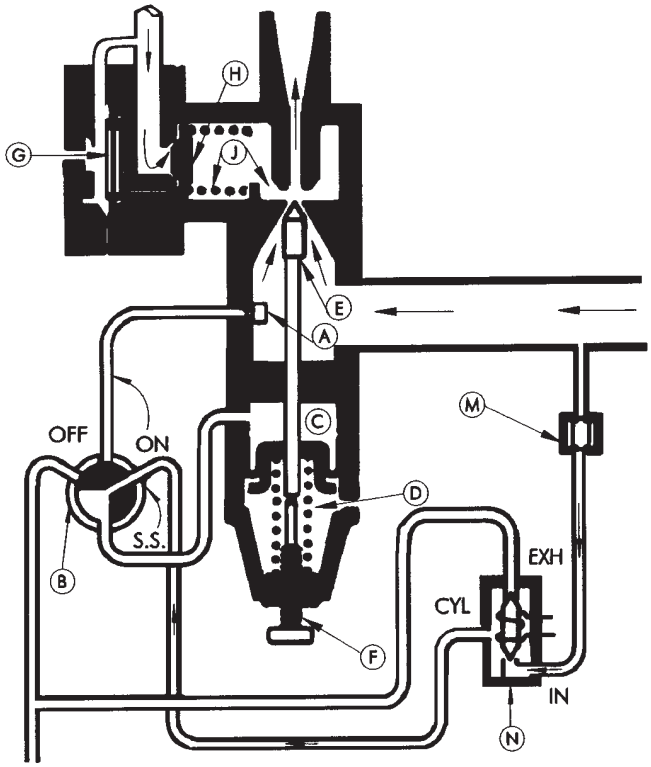
FOR APPLICATION AGAINST PRESSURE



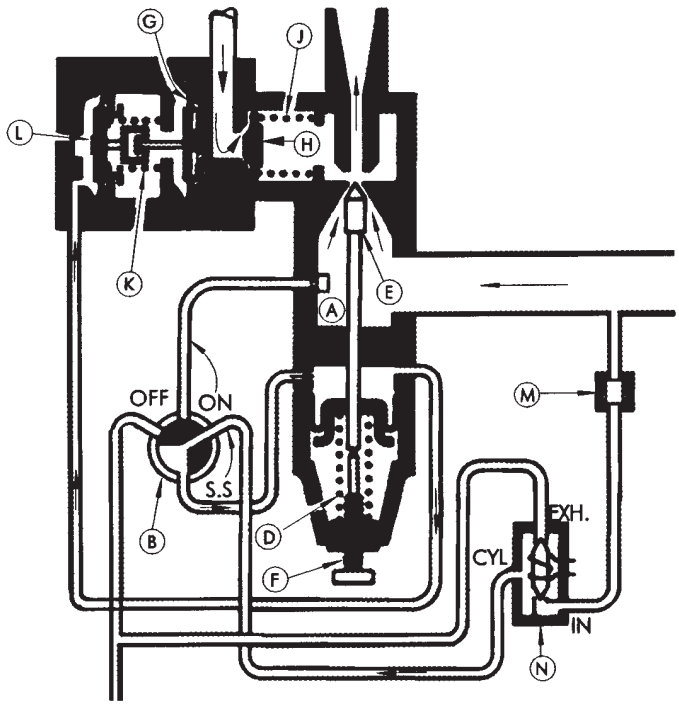
WITH SUCTION SHUT-OFF UNIT
FOR APPLICATIONS NEGATIVE HEAD

2" INJECTOR - FLOW DIAGRAM
Manually Operated

25.100.181.011
ISSUE 4 5-97



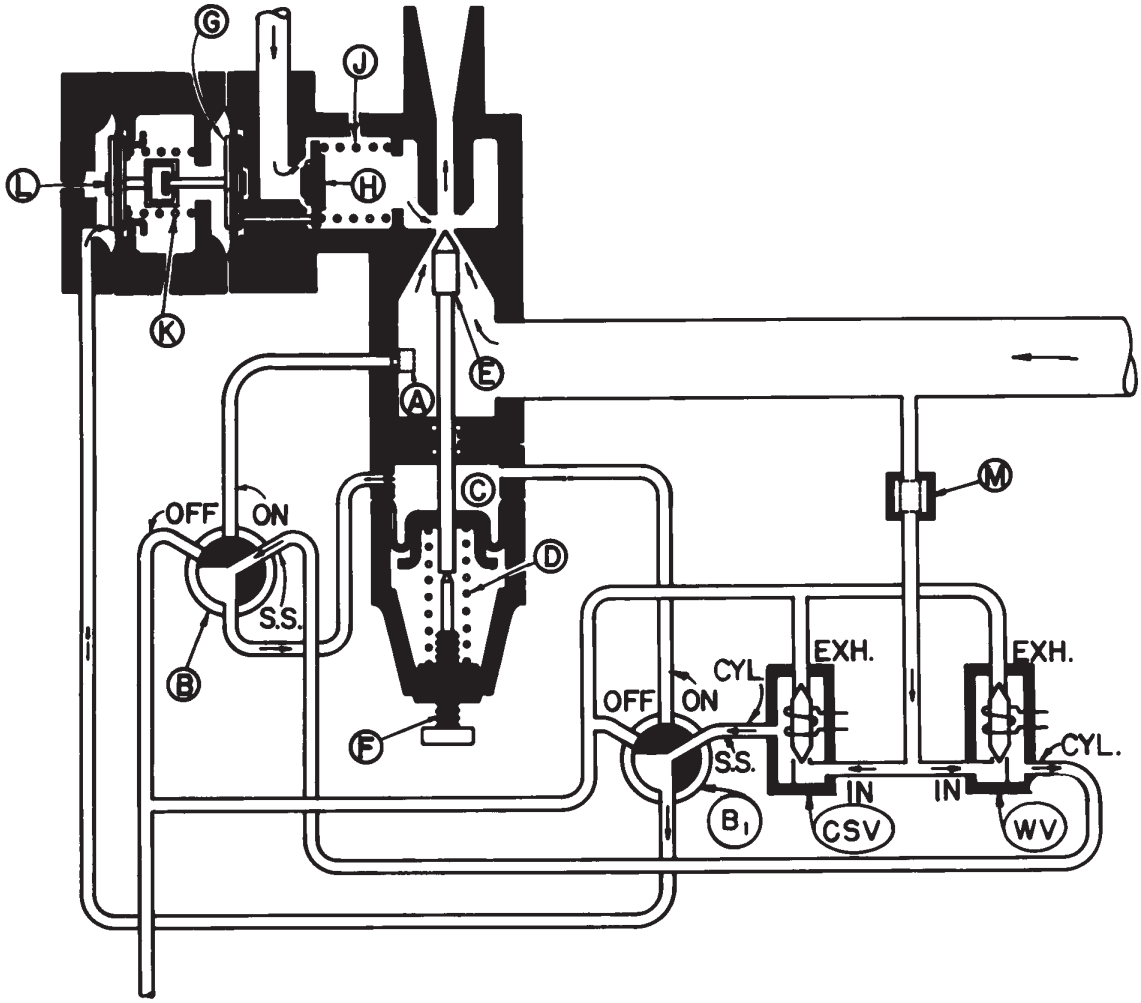
FOR APPLICATION AGAINST PRESSURE



WITH SUCTION SHUT-OFF UNIT
FOR APLICATION AGAINST NEGATIVE HEAD

2" INJECTOR - FLOW DIAGRAM
Intermittent Start-Stop Operation

25.100.181.021
ISSUE 3 5-97



2" INJECTOR - FLOW DIAGRAM
Prime & Flush Operation

25.100.181.031
ISSUE 4 5-97

SECTION 4

SECTION 4 - SERVICE

List Of Contents

WARNING: HAZARDOUS GAS IS PRESENT IN THIS EQUIPMENT DURING NORMAL OPERATION. TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT, READ THIS INSTRUCTION BOOK AND THE APPROPRIATE GAS MANUAL BEFORE CONNECTING THIS EQUIPMENT TO A SUPPLY OF GAS. OPERATION AND MAINTENANCE OF THIS EQUIPMENT MUST BE RESTRICTED TO TRAINED, QUALIFIED PERSONNEL WHO ARE COMPLETELY FAMILIAR WITH THESE INSTRUCTIONS. TO AVOID POSSIBLE SEVERE PERSONAL INJURY FROM ELECTRICAL SHOCK, TURN OFF POWER BEFORE SERVICING. EXCEPT IN CASES OF LEAK DETECTION OR CALIBRATION ADJUSTMENTS, THE GAS SUPPLY MUST BE COMPLETELY SHUT OFF AT THE GAS SUPPLY CONTAINER(S) AND THE GAS IN THE SYSTEM EXHAUSTED BEFORE SERVICING THE EQUIPMENT. TURN OFF POWER TO CONTROLLER.

4.1 General Care of Equipment

Maintenance is simplified if certain general precautions are taken. These are usually easy to accomplish and will contribute to reducing maintenance costs by maintaining normal operating conditions. The recommended precautions are as follows:

4.1.1 Checking for Leaks

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY, IT IS GOOD PRACTICE TO HAVE AN APPROVED GAS MASK AVAILABLE WHEN MAKING LEAK CHECKS.

- **CHLORINE LEAKS**

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, DO NOT TOLERATE ANY LEAKS. THEY ALWAYS GET PROGRESSIVELY WORSE AND MUST BE CORRECTED PROMPTLY.

NOTE: For leak testing, use Evoqua Water Technologies U409 or Commercial 26° Baume' aqua ammonia. Household ammonia is not strong enough.

A bottle of aqua ammonia is furnished for checking leakage of chlorine gas at joints, valves, etc. Hold the moistened dauber close to the joint or suspected leakage area. If leakage exists, a white cloud will form. When a leak is found, immediately shut off the gas supply and remove the escaped gas by ventilation. Continue injector operation for three minutes to remove all gas from the machine.

WARNING: ESCAPED GAS MUST BE EXHAUSTED TO OUTSIDE ATMOSPHERE. THE EXHAUST SYSTEM MUST TERMINATE IN AN AREA WHERE GAS FUMES CANNOT CAUSE INJURY TO PERSONNEL OR DAMAGE TO PROPERTY. DO NOT TERMINATE THE EXHAUST SYSTEM AT A LOCATION ROUTINELY USED BY PERSONNEL, SUCH AS WORK AREAS OR PATHWAYS, NOR NEAR WINDOWS OR VENTILATION SYSTEM INTAKES.

Eliminate the leak before proceeding.

As a routine practice, check gas connections for leaks once a day. Green or reddish deposits on metal parts indicate possible leaks. No odor should be in evidence around equipment except when a joint is temporarily opened.

CAUTION: When any connection is broken for even 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.

- **WATER LEAKS**

  As a matter of routine maintenance, tolerate no water leaks. Repair all water leaks as soon as they are discovered.

4.1.2 Plastic Parts

Whenever threaded plastic parts are assembled, use Halocarbon grease on straight and Acme threads, and Teflon tape on tapered threads, to prevent the parts from freezing together. In general, do not use tools to make up plastic connections. Make this type of connection by hand only.

4.2 Cleaning Parts

If the rotameter tube, the rotameter float, the V-notch plug, or any valve seats or passages become contaminated with impurities sometimes found in the gas, remove and clean them. Most of the residue that accumulates on the parts can be removed with warm water and a detergent. Wire brushes, scrapers, and the like should be avoided as they will damage the parts. Refer to the appropriate section in this instruction book.

WARNING: DO NOT USE HYDROCARBONS OR ALCOHOLS BECAUSE RESIDUAL SOLVENT MAY REACT WITH THE GAS. SOLVENTS CAN PRODUCE SERIOUS PHYSIOLOGICAL EFFECTS UNLESS USED IN STRICTEST COMPLIANCE WITH THE SOLVENT MANUFACTURER'S SAFETY RECOMMENDATIONS.

All traces of detergent or moisture must be removed from the parts before they are returned to service. Do not use heat on plastic parts.

4.3 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.

4.4 Tools

When working with screws, bolts, nuts, and other hardware, use the proper size tools to avoid damage to screw heads, nuts, etc. This precaution will make it easier to remove these parts when necessary.

4.5 Gaskets/O-Rings

Keep a supply of gaskets and O-rings on hand so that gasketed joints can be maintained in proper condition. A regular replacement program for gaskets will do much to eliminate operating difficulties. The preventive maintenance kit includes a set of gaskets.

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, NEVER REUSE GASKETS. ALWAYS REPLACE WITH A NEW GASKET OF THE PROPER SIZE AND MATERIAL, AS IDENTIFIED ON THE EQUIPMENT PARTS DRAWING.

4.6 Changing Gas Supply Cylinders

Refer to the separate instruction book provided with the vacuum regulator-check unit for detailed instructions and precautions.

4.7 Injector

The injector is a highly important part of the gas feeder, since proper operation of the system depends upon good injector performance. Each gas feeder is equipped with an injector that is selected at the factory to suit the installation conditions. Before shipment, the gas feeder is tested under stated operating conditions to insure that it will deliver the required flow of gas when operated under the hydraulic conditions specified on the Evoqua Water Technologies shipping order. If difficulty is experienced in obtaining the specified capacity at time of installation, check the injector operating water pressure and the backpressure to see that they conform with the values specified on your or-

der. If operating difficulties are encountered after the gas feeder has been in operation, study the injector parts drawing so that you are completely familiar with the assembly of the injector.

A strainer is required in the water line ahead of the injector to avoid plugging of the injector throat ports by foreign material. If sufficient material is allowed to build up on the strainer surface, the resultant pressure drop across the strainer reduces the injector operating water pressure. If the pressure drop is excessive, the injector will not be able to induct the required gas flow. Regular periodic inspection and cleaning of the strainer will minimize this possibility.

4.8 Maintenance

Maintenance of a Series V-2000 Gas Feeder consists of three periodically performed operations:

- Periodic Performance Checks to detect the onset of any deteriorating conditions before their progress leads to serious malfunction.

- Periodic Cleaning to remove contaminants and deposits brought to the vacuum regulator-check unit and control module by the gas flow and to the injector by the water flow.

- Periodic Preventive Maintenance to disassemble, inspect, clean, and accomplish recommended parts replacement. Kits of replacement parts required for this periodic maintenance are available and are listed in Section 6, Preventive Maintenance Kits and Spare Parts List.

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

NOTE: If the gas feeder is used seasonally or with a long-term shut-down, the preventive maintenance should be performed prior to startup.

4.8.1 Performance Check

To assure that all elements of your system are functioning in a normal manner, it is recommended that the following checks be made at approximately three-month intervals. These checks are easy to perform and require no tools.

a. With the gas turned on at the supply container valve and the vacuum regulator-check unit, and with the injector operating, vary the feed of the gas feeder through its full range. The gas feeder should feed steadily and hold any rate set from the maximum of the rotameter down to 1/20th of maximum. The rotameter float should not stick or behave erratically at any point.

b. With the injector still operating, turn off the gas at the supply container valve. In a few moments, the vacuum gauge should indicate a rising vacuum. After initially rising, the rotameter float will sink lower and lower in the tube until finally it is resting on the bottom stop. Decrease the feed rate, if necessary, to prevent the float from bouncing violently and damaging the glass tube. Failure of the float to settle down indicates an air leak somewhere upstream of the rotameter.

c. When the rotameter float has settled down, turn off the injector operating water. A rapid decrease in vacuum indicates an air leak somewhere in the system.

4.8.2 Cleaning

Perform at intervals as tabulated below:

MAINTENANCE ITEM	WHEN TO PERFPRM
Vacuum Regulator-Check Unit	Refer to separate instruction book.
Rotameter	When deposits are seen inside the glass tube or the float sticks in one place.
V-Notch Plug	At same time as rotameter.
Injector Throat and Tailway	Every six months.

NOTE: The actual frequency of cleaning will depend on calendar time, the feed rate and amount of gas fed, the care exercised in container changing, the source of gas, and the quality of the operating water. The above maintenance schedule provides recommended cleaning intervals; however, your own operating experience is the best guide to preventive maintenance and may result in significant variations from the recommended schedule.

4.8.3 Cleaning Rotameter

If a milky-white, powdery-white, green-slimy, or brown-oily deposit is visible inside the rotameter tube, or if the float has particles clinging to it or tends to stick to the tube wall at lower feeds, it is time to clean the rotameter. Proceed carefully to avoid dropping the glass tube or losing the float down a floor drain or grating. To facilitate handling the float, have a clean cup, such as a coffee cup or a small beaker, and a pair of tweezers at hand before starting. Proceed as follows:

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, SHUT DOWN THE GAS FEEDER AND EXHAUST ALL GAS AS DIRECTED IN PARAGRAPH 3.2.3, STOPPING - FOR EXTENDED PERIODS.

a. Turn off the injector operating water.

b. Remove rotameter. Take care not to lose the end stops, the float, or any of the O-rings or gaskets.

c. Place the end stops and float into the cup mentioned.

d. Many gas contaminants are soluble in water. Hold the tube end under running warm (110-125°F) water so that the water enters the tube at one end and exits at the other to flush out deposits. Alternately, soak the tube in a container of warm water for about 30 seconds. Then hold the tube, half full with water, with palms capping the ends, and shake vigorously endwise for a few seconds. Discharge the water and repeat until clean. A common pipe cleaner may be used to scrub the interior. A detergent will promote cleaning action.

e. Drain and let dry. Do not use a pipe cleaner as a drying tool because the lint from it will stick to the tube interior. Place the tube at an angle between a horizontal and a vertical surface (as between a shelf and a wall) with both ends open so air can flow through. Drying will be hastened by heat, as from a light bulb nearby. Do not blow through the tube as moisture from the breath will condense on the tube walls.

f. To clean the float, pour about an inch of warm to hot (130-150°F) water into the cup containing the float. Grasp the float with tweezers and shake it side to side while submerged for a few seconds. Release the float and pick it up again and repeat the action several times so all surfaces are washed. Hold the float with the tweezers, discard the wash water, and repeat the above. A few drops of detergent will improve the process. Do not use your fingers to hold the float.

g. Allow the float to dry on a clean surface and then, with tweezers, place it in a clean, dry cup.

NOTE: Do not attempt to dry the float with a rag or paper towel as electrostatic forces will make lint and other particles stick to the float.

h. Clean stops with water and dry thoroughly before reassembly.

i. When tube, float, and stops are clean and dry, wipe a thin film of Halocarbon grease on the bottom O-ring and proceed with reassembly as described in Section 2 - Installation. Resume operation of the gas feeder.

4.8.4 Cleaning V-Notch Plug (See Drawing 25.055.000.032)

The same contaminants seen in the rotameter are in the gas stream flowing through the V-notch orifice, and may also deposit at this point. When the rotameter is cleaned, clean the V-notch plug at the same time. If, at any time, float movement in the rotameter is not proportional to V-notch plug adjustment, as shown by a sudden marked rise or drop for a small amount of plug adjustment, the V-notch plug requires cleaning.

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, SHUT DOWN THE GAS FEEDER AND EXHAUST ALL GAS AS DIRECTED IN PARAGRAPH 3.2.3, STOPPING - FOR EXTENDED PERIODS.

a. Shut off the injector water supply.

b. Remove the V-notch assembly completely from the control module as follows:

NOTE: If desired, the rotameter can be installed or removed from the front of the module by removing the top front panel. Insert the fingertips of one hand in the recesses at the lower front of the panel, hold the top of the panel with the other hand, and swing outward and push upward.

(1) Rotate knob to lower rack as far as possible.

(2) Disconnect clamp (78).

(3) Unscrew bottom cap (5).

(4) Pull plug stem (8) straight down until the V-notch plug is free.

c. Using running water or a cup full of water and a small, stiff brush, such as a toothbrush, scrub out the V-notch groove and the shank of the plug. Do not use a knife, scraper, or file to clean out the groove. Dissolving action and scrubbing are all that is required.

d. Dry the plug with a clean cloth or paper towel.

e. Wipe a thin film of Halocarbon grease on the gaskets of the V-notch assembly. Reinstall it in the control module and resume operation.

4.8.5 Cleaning Injector Throat And Tailway

The injector will not operate properly unless all the ports are clear. This point is easily checked visually after the throat has been removed.

Water containing carbonates, manganese, or iron will frequently leave a deposit in injector tailways. As this deposit increases in thickness, it can become scaly or rough and adversely affect pressure recovery or increase backpressure so that the injector fails to develop adequate operating vacuum. Such deposits are readily recognizable by their black or reddish color. They may be removed by immersing the throats in dilute (10%) hydrochloric acid, known commercially as muriatic acid.

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE WHEN USING HYDROCHLORIC ACID, OBSERVE ALL SAFETY PRECAUTIONS RECOMMENDED BY THE ACID MANUFACTURER/ SUPPLIER.

If the upstream strainer becomes corroded or perforated and passes a small pebble or other tramp material, such particles can partially plug the throat and prevent adequate flow. Water containing suspended silt or sand particles can erode the opening in the throat. As this opening is enlarged, the water velocity decreases, thereby decreasing the vacuum developed.

The injector should develop a dynamic vacuum of at least nine inches of mercury with a maximum capacity flow rate. At lower gas feed rates it tends to be higher for the same hydraulic conditions. With the gas completely shut off, the static vacuum should be about 25 to 28 inches of mercury.

If the gas feeder fails to operate, inadequate vacuum is the most common reason and the injector is the first place to check. Proceed as directed in Section 4.10 - Troubleshooting.

4.8.6 Vibrating Noise During Operation

Two types of valve oscillation can cause an audible vibration:

High frequency vibration at low feed rates, usually below 2000 pounds per 24 hours. This vibration, usually a humming noise, is generated at the differential regulating valve or trimmer valve.

- OR -

Low frequency, high amplitude, “galloping” type of vibration, which usually causes an oscillation (swinging) of the vacuum gauge.

a. The high frequency hum is generated by vibrations at the seat and stem of the differential regulating or trimmer valve. The cause may be air leakage, off-centered diaphragm, or friction. Correct the condition as follows:

   (1) Locate any air leakage by pressure checking the assembly, especially at the rotameter. Eliminate the leaks.

   (2) Check for off-center diaphragm by ensuring that the diaphragm protrudes evenly at the clamped face of the valve halves. If necessary, loosen all the screws and shift the diaphragm to recenter it. Retighten the screws.

   (3) Noise at the differential regulating or trimmer valve may be eliminated by changing the number of Teflon gaskets used between the tube seat and valve body. Remove or add one gasket at a time, leaving one to four gaskets.

NOTE: The removal of ALL gaskets may limit the maximum feed rate. Too many gaskets may prevent reaching low feed rates.

b. The low frequency, "galloping" type of oscillation may be generated by air binding of the solution line causing the vacuum level to vary. It may also be caused by the trimmer valve drain hose acting as a resonance chamber. Correct these conditions as follows:

(1) If injector vacuum level is swinging, check for gas binding in the solution line caused by traps. Eliminate the traps by adjusting the water volume through the injector throat and purging the solution line of gas pockets.

(2) Remove or pinch off the drain hose from the trimmer valve. If this reduces the noise, change the size or length of the drain hose (if possible) or provide an air break in the drain line to stop the resonance.

4.9 Periodic Preventive Maintenance

Because of aging of elastomeric components and the desirability of checking internal zones for possible accumulations of deposits not seen in routine maintenance, it is recommended that, at one-year intervals, each of the principal components of the system be completely disassembled. Before starting the work, ensure that the appropriate preventive maintenance kits are on hand.

NOTE: If the gas feeder is used seasonally or with a long-term shut-down, the preventive maintenance should be performed prior to startup.

Refer to the tabulated listing below and Section 6 of this book for appropriate kit numbers.

Disassembly and reassembly instructions necessary to install the maintenance kit parts are included in the kit(s).

MAINTENANCE ITEM	WHEN TO PERFORM	MAINTENANCE KIT NUMBER
Vacuum Regulator-Check Unit	Refer to separate instruction supplied with equipment.	
Control Module	At one-year intervals.	U29171
Plastic Tubing, Corporation Cock & Solution Tube	At one-year intervals.	Refer to parts list.

Servicing of Evoqua Water Technologies equipment, including installation of parts from maintenance kits, should be restricted to trained, authorized personnel who are completely familiar with the entire contents of the equipment

instruction book. The Evoqua Water Technologies sales office or the dealer from whom you purchased the equipment can provide the preventive maintenance kits or overhaul service.

4.9.1 Disassembly of Differential Regulating Valve (See Drawing. 25.055.017.010)

a. Remove four two-inch screws (2). Mark the location of these screws by drawing a line from the upper plate (1) to the body assembly (14).

b. The valve is spring loaded. Hold down the upper plate when removing the last of the 14 machine screws (14) and the 14 hex nuts (5).

c. Squarely remove the upper plate from the body assembly. Remove the diaphragm assembly (2) and O-ring (3). Discard the O-ring.

d. Remove the stem (8) from the diaphragm unit. Remove and discard the O-ring (7).

4.9.2 Reassembly of Differential Regulating Valve

a. Refer to cleaning procedure.

b. Wipe a thin film of Halocarbon grease onto all O-rings before reassembling.

c. Reassemble in the reverse order of disassembly. Check for gas leaks. Make required adjustments and restore unit to normal service.

4.9.3 Removal of Drain Valve Unit (See Drawing 25.055.000.032)

a. Unscrew the tubing nut (65) and disconnect the tubing (96) from the drain valve unit (16).

b. See drawing 25.055.021.010. Unscrew tubing nut (7) and disconnect the tubing from the drain valve unit (16).

c. Unscrew the union nut (41) from the trimmer valve (19). Remove and discard the O-ring (40).

d. Remove the screw that secures the valve unit to the bracket (91).

e. Remove the drain valve unit.

4.9.4 Disassembly of Drain Valve Unit (See Drawing 25.055.021.010)

a. Unscrew and remove the plug (18).

WARNING: SPRINGS (3 AND 14) ARE IN A COMPRESSED STATE. TO AVOID POSSIBLE SEVERE PERSONAL INJURY, RESTRAIN THE PARTS DURING DISASSEMBLY TO PREVENT FORCEFUL EJECTION OF THE PARTS.

b. Unscrew the cap (1) and remove the cap along with the spring, the stem unit (4), and the guide retainer (2).

CAUTION: Do not attempt to remove the Teflon seat (5) from the drain housing (6). These parts are press-fitted.

c. Remove the screws (10 and 11) and nuts (9) securing the outlet housing (17) to the drain housing. Mark the location of the longer bracket attaching screw.

d. Separate the two housings. Remove and discard the O-ring (12).

e. Separate removed parts, the diaphragm (13), and the spring (14) from the housing.

CAUTION: Do not attempt to remove the stem (15) from the diaphragm or the Teflon seat (16) from the outlet housing. These parts are press-fitted.

4.9.5 Reassembly of Drain Valve Unit

a. Refer to the cleaning procedure.

b. Wipe a thin film of Halocarbon grease onto the O-ring before assembling.

c. Apply Halocarbon grease to threads of the drain housing (6) before assembling the cap (1).

d. Apply Teflon tape to all tapered pipe joints.

e. Reassemble in the reverse order of disassembly.

NOTE: The long screw is used at the marked location to secure the valve to the support bracket.

f. Reinstall the drain valve unit in the reverse order of removal.

4.9.6 Removal and Disassembly of Check Valve (See Drawing 25.055.000.032)

a. Unscrew and remove the valve clamp nut (74) from the check valve body (89).

b. Remove and discard the O-ring (81).

c. Unscrew the valve body from the elbow (70).

d. Remove and discard the umbrella valve (82) from the valve body.

4.9.7 Reassembly and Installation of Check Valve

a. Refer to cleaning procedure.

b. Apply a light coating of Halocarbon grease to the O-ring (81) before installing.

c. Apply Halocarbon grease only to the stem or tip of the umbrella valve.

d. Reassemble in the reverse order of disassembly.

4.9.8 Removal of Trimmer Valve (See Drawing 25.055.000.032)

NOTE: The check valve and drain valve have been previously removed.

a. Unscrew the union nut (48). Discard the gasket (37).

b. Remove the nut (44) that secures the bracket (91) to the trimmer valve (19).

c. Unscrew the tubing nut (65) and disconnect the tubing (96) from the elbow (93).

d. Remove the four plastic nuts (11, Drawing 25.055.022.010) and lift out the valve.

4.9.9 Disassembly of Trimmer Valve (See Drawing 25.055.022.010)

a. Remove the five two-inch machine screws (10), 11 machine screws (8), and 16 hex nuts (9). Separate the body assembly (21) from the housing (13). Discard the O-ring (20).

b. Mark the position of the hex nuts (1) on the valve rod (12). Remove the hex nuts, seal adapter (6), shaft seal (7), sleeve (5), adapter (3), and spring (4).

c. Pull the diaphragm assembly (22) and valve rod parts from the housing.

4.9.10 Reassembly of Trimmer Valve

a. Refer to cleaning procedure.

b. Wipe a thin film of Halocarbon grease onto the O-ring before reassembling.

c. Restore the hex nuts (1) to their original positions during reassembly.

d. Reassemble in the reverse order of disassembly. Check for gas leaks. Make required adjustments and restore unit to normal service.

4.9.11 Adjustment of Trimmer Valve (See Drawing 25.055.022.010)

The injector vacuum gauge line is connected to the seat (23) in the trimmer valve body (21). If this connection is moved to a port in the housing (21), the indicated vacuum may be adjusted as follows:

a. Unlock the hex nut (1).

b. Using a suitable tool on the flats of the valve rod (12) to prevent the rod from turning, rotate the inner hex nut (1) as necessary to obtain the required vacuum.

NOTE: Loosening the nut will decrease the vacuum, while tightening will increase the vacuum.

c. With desired vacuum set, lock this setting by tightening the outer jam nut.

4.9.12 Removal of Injector Plug (Two-Inch Bellofram Type Injector, Drawing 25.052.001.046)

CAUTION: If the injector plug is to be removed for cleaning or replacement, it is essential that the plug rod (6) be held with a wrench so it cannot rotate when the plug is unscrewed. Rotation of the plug rod will cause damage to the bellofram (16).

4.9.13 Replacement of Bellofram (See Drawing 25.052.001.046)

Damage to the bellofram (16) is indicated by a continuous flow of water from the injector shut-off valve drain when the valve is in the OFF position or by the failure of the injector to operate when the valve is in the ON position.

To replace the bellofram, proceed as follows:

a. Remove the adjusting screw nut (19) with the adjusting screw (21), the lock nut (20), and the spring (50).

b. Remove the connecting tube (26).

c. Remove the two 1/2-inch cap bolts (49) and lower the entire lower portion of the injector, including the plug rod (6) and the plug (4).

d. Remove the old bellofram and assemble the new one on the plug rod (6).

e. Locate the bellofram on the backing cup (15).

f. Reassemble the injector.

4.9.14 Vacuum Gauges

CAUTION: Do not disassemble diaphragm unit from vacuum gauge.

4.9.15 Adjustment of V-Notch Plug Linkage

When the controller is receiving a zero flow signal, loosen the hex nut at the top of the rack in the control module and rotate the coupling screw until the V-notch plug is at its zero position (see drawing 25.200.150.010). Then tighten the hex nut.

4.10 Troubleshooting

The following troubleshooting table is provided for determining and correcting most common troubles.

Table 4.1 - Troubleshooting

Basic Instructions:	1. Measure the vacuum over the full range of gas flow (low, half, and full feed). 2. Compare what you measure with figures given on the Flow Diagram drawing. If the figures are right, leave that component alone and check the next element. 3. Make checks, as necessary, to pinpoint the problem. **<u>WARNING</u>: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, TURN OFF THE GAS SUPPLY, EXHAUST GAS IN LINES AND TURN OFF WATER SUPPLY BEFORE PERFORMING ANY DISASSEMBLY OPERATIONS FOR TROUBLESHOOTING PURPOSES. REFER TO OPERATION-STOPPING.**					
OPERATING SYMPTOMS	**PROBABLE CAUSE**	**WHAT TO MEASURE**	**HOW TO MEASURE**	**TYPICAL VALUES FOR PROPER OPERATION**	**ADDITIONAL CHECKS**	**REMEDY**
GAS FEEDER WILL NOT COME UP TO FULL FEED. GAS PRESSURE ADEQUATE.	Insufficient injector vacuum.	Injector vacuum. V-Notch differential.	Observe gauge on machine if it has one. If there is no built-in gauge, connect a vacuum gauge or a mercury manometer at gas inlet to injector. Connect a U-tube water manometer upstream and downstream of V-Notch chamber.	With gas flowing, six inches of mercury (nine inches for 10,000 lb/24 hr minimum). With gas shut off, 25 to 28-1/2 inches of mercury static vacuum. Seven to 16 inches of water.	Measure operating water pressure just upstream of injector and backpressure just downstream of injector. Compare with injector data. Check piping for smooth flow immediately downstream of injector tailway. (No elbows, tees, reducers, etc.). Check for air leaks through diaphragm of diaphragm-type injector check valves. Where injector vacuum is marginal or hydraulics are borderline, V-notch differential is a more sensitive indicator of adequate operating vacuum than the injector vacuum gauge. A "bobbing" rotameter float indicates marginal vacuum.	Clean injector throat and tailway. Clean or replace solution discharge tubing. Provide adequate operating water pressure. **<u>NOTE</u>: A larger throat and tailway may only compound the problem as the greater flow creates greater backpressure.**

Table 4.1 - Troubleshooting (Cont'd)

OPERATING SYMPTOMS	PROBABLE CAUSE	WHAT TO MEASURE	HOW TO MEASURE	TYPICAL VALUES FOR PROPER OPERATION	ADDITIONAL CHECKS	REMEDY
GAS FEEDER FEEDS NORMALLY AT HIGH RATES BUT WILL NOT CONTROL AT LOWER RATES.	Vacuum regulator-check unit not throttling sufficiently, (held open by a particle of rust, ferric chloride, etc.). - OR - Possibly a bad diaphragm in differential regulating valve is causing by-passing of the V-notch control valve.	Regulated vacuum. Differential regulating valve.	Disconnect cap from elbow in pressure check-pressure relief valve. Connect a single leg water manometer at elbow opening. Connect a U-tube water manometer across differential regulating valve.	13 to 48 inches of water. Seven to 16 inches of water differential.	Note especially if vacuum falls at lower feeds. If it does, either air or gas must be causing it. To determine which, turn off gas at container. If rotameter float drops, excess gas was flowing. If turning off gas does not cause the float to drop, air must be leaking in. Then, close off vacuum relief port. If float drops, air was leaking through the diaphragm. If closing the vent has no effect, air is leaking past a gasket. Pressurize top of differential regulating valve with aire and check for leaks in water.	Clean vacuum regulator-check unit. Check diaphragms for "pin hole" leaks. Check gaskets. Replace diaphragm.

Table 4.1 - Troubleshooting (Cont'd)

OPERATING SYMPTOMS	PROBABLE CAUSE	WHAT TO MEASURE	HOW TO MEASURE	TYPICAL VALUES FOR PROPER OPERATION	ADDITIONAL CHECKS	REMEDY
GAS FEEDER CONTROLS NORMALLY AT LOW FEED BUT IS ERRATIC WHEN FULL FEED IS ATTEMPTED. INJECTOR VACUUM NORMAL.	Not enough gas entering to satisfy demand. Dirty vacuum regulator-check unit or partially clogged gas line.	Regulated vacuum.	Disconnect cap from elbow in pressure check-pressure relief valve. Connect a single leg water manometer at elbow opening.	13 to 48 inches of water. If gas line or vacuum regulator-check unit is partially clogged, the vacuum will increase. **CAUTION: Start at low feed rates; gradually increase feed to prevent "blowing" manometer.**	Check gas supply pressure.	Clean vacuum regulator-check unit. Clean high-pressure gas line. Supply adequate gas pressure. (30 psi is the minimum for full feed performance.)
GAS FEEDER DOES NOT FEED. GAS PRESSURE IS ADEQUATE. INJECTOR VACUUM IS NORMAL.	Tube connection from upstream of V-notch to top of differential regulating valve is disconnected or leaking.	Regulated vacuum.	Disconnect cap from elbow in pressure check-pressure relief valve. Connect a single leg water manometer at elbow opening.	13 to 48 inches of water.	On automatic machines, make sure V-notch plug is not remaining in closed position.	Reconnect tube line. Replace tube if cracked, kinked, or defective at ends. Tighten tube nuts.

WARNING LABELS AND TAGS

The following warning labels and tags are attached to the equipment.

L2016: TO AVOID POSSIBLE SEVERE PERSONAL INJURY FROM ELECTRICAL SHOCK, TURN POWER OFF BEFORE SERVICING.

L2708: CHLORINE, WHICH IS A HAZARDOUS CHEMICAL, IS PRESENT IN THIS EQUIPMENT DURING NORMAL OPERATION. TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DEATH, YOU MUST OBSERVE THE FOLLOWING PRECAUTIONS:

1. When changing chlorine supply containers you must be completely familiar with your local plant operating and emergency procedures, including the location and use of a gas mask. Recommended emergency procedures can be obtained from your chlorine supplier, the Chlorine Institute, Inc., or similar organization.
2. Do not open the chlorine supply container valve more than one complete turn. This will permit maximum discharge and can be turned off quickly in the event of a leak.
3. On a routine daily basis, starting at the chlorine supply container(s), thoroughly check all joints, connections, and equipment for possible chlorine leaks and immediately correct any found. Do not tolerate any chlorine leaks.
4. Chlorine leaks never get better. Chlorine leaks always get progressively worse if they are not promptly corrected.
5. Never re-use gaskets in chlorine piping systems. Always have an adequate supply on hand and always use new gaskets of the correct size and material as identified on the equipment parts drawings.
6. Except in cases of leak detection or calibration adjustments, the chlorine supply must be shut off at the supply container valve(s) and the chlorine in the system completely exhausted before servicing the equipment.
7. It is recommended practice to have an approved gas mask available, which you have been trained to use, when making chlorine leak checks and when changing chlorine supply containers.

WARNING LABELS AND TAGS (CONT'D)

8. The Evoqua Water Technologies instruction book provided with this equipment furnishes complete and detailed instructions for its installation, operation, and maintenance, and must be referred to for that detailed information.
9. The Evoqua Water Technologies instruction book provided with this equipment also furnishes technical information on the characteristics, storage, and handling of chlorine, and must be referred to for that information. Contact your chlorine supplier, the Chlorine Institute, Inc., or similar organization to obtain more detailed information.
10. Operation and maintenance of this equipment must be restricted to trained, qualified personnel who are completely familiar with these instructions.

DO NOT REMOVE THIS SIGN FROM THIS EQUIPMENT

P60168: HAZARDOUS GAS IS PRESENT IN THIS EQUIPMENT DURING NORMAL OPERATION. TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT, READ THE EVOQUA WATER TECHNOLOGIES INSTRUCTION BOOK AND THE APPROPRIATE GAS MANUAL BEFORE CONNECTING THIS EQUIPMENT TO A SUPPLY OF GAS. OPERATION AND MAINTENANCE OF THIS EQUIPMENT MUST BE RESTRICTED TO TRAINED, QUALIFIED PERSONNEL WHO ARE COMPLETELY FAMILIAR WITH THESE INSTRUCTIONS.

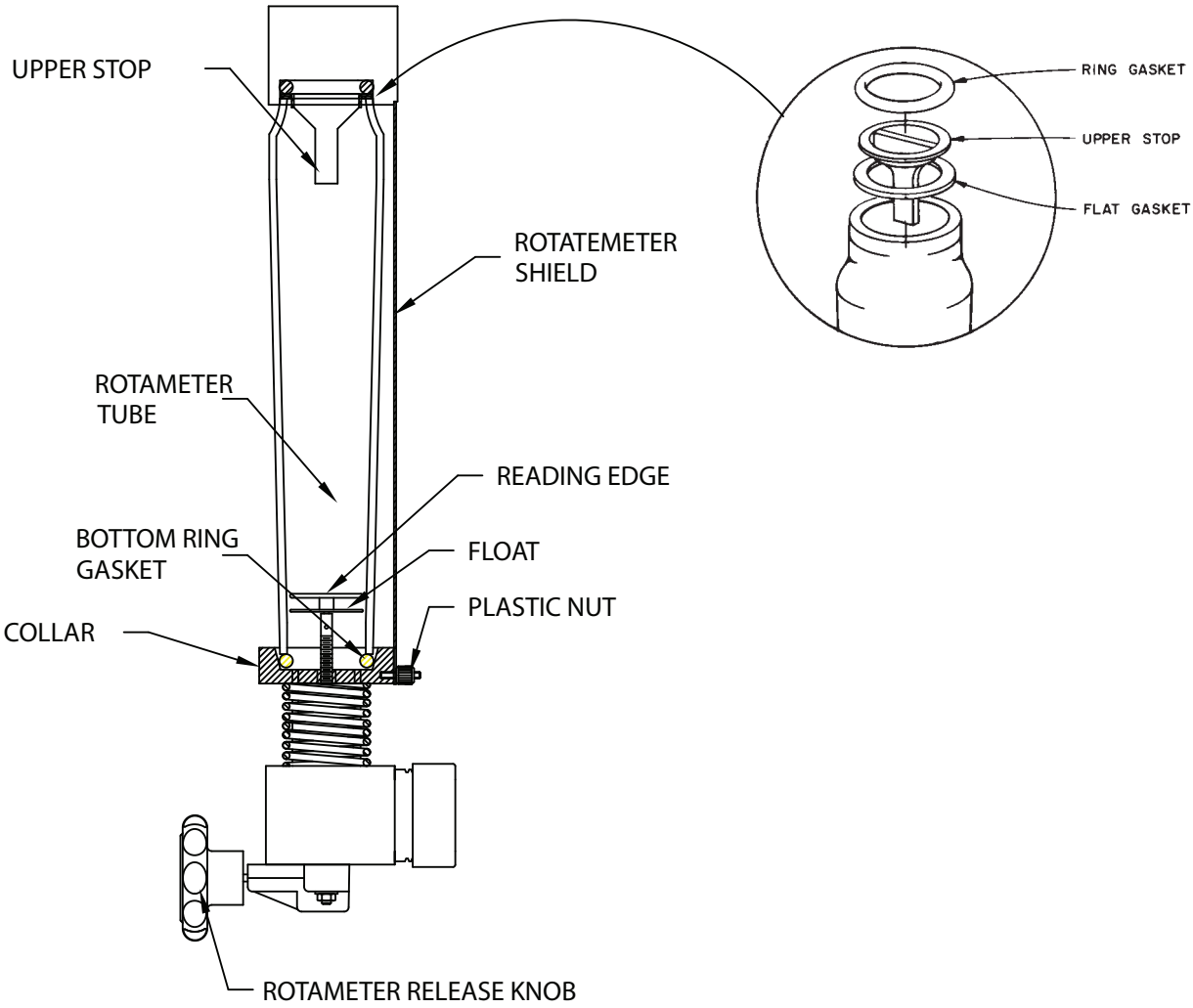
THIS UNIT IS DESIGNED TO OPERATE UNDER VACUUM ONLY. TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO EQUIPMENT, DO NOT CONNECT TO A SOURCE OF GAS UNDER PRESSURE. SEE INSTRUCTION BOOK FOR FULL DETAILS BEFORE INSTALLATION.

DO NOT USE THIS EQUIPMENT FOR SWIMMING POOL, WATER PARK, OR SIMILAR RECREATIONAL APPLICATIONS. IT IS NOT SOLD FOR SUCH USE.

CAUTION LABELS AND TAGS

The following caution labels and tags are attached to the equipment.

L2076:	DO NOT DISASSEMBLE DIAPHRAGM UNIT FROM PRESSURE SENSOR.
P4373:	PULL OUT STEM TO FULL LENGTH OF CHAIN BEFORE CLOSING VALVE.
L3259:	TO PREVENT DAMAGE TO MODULE, REPLACE SHIMS UNDERNEATH MODULE AFTER PLYWOOD FEET ARE REMOVED.
L2557:	FOR CHLORINE, SULFUR DIOXIDE, AMMONIA, OR CARBON DIOXIDE USE ONLY.
L2193:	KEEP COVER SECURELY TIGHTENED. THIS ENCLOSURE IS NEMA 4 RATED. GASKET SEAL MUST BE MADE IN ORDER TO PROTECT THE INTERNAL COMPONENTS FROM MOISTURE AND FUMES.



NOTE: IF DESIRED, THE ROTAMETER CAN BE INSTALLED OR REMOVED FROM THE FRONT OF THE MODULE BY REMOVING THE TRIM PANEL. INSERT FINGERTIPS IN RECESSES IN LOWER FRONT OF TRIM PANEL. PUSH UPWARD AND SWING OUTWARD.

TO INSTALL ROTAMETER:

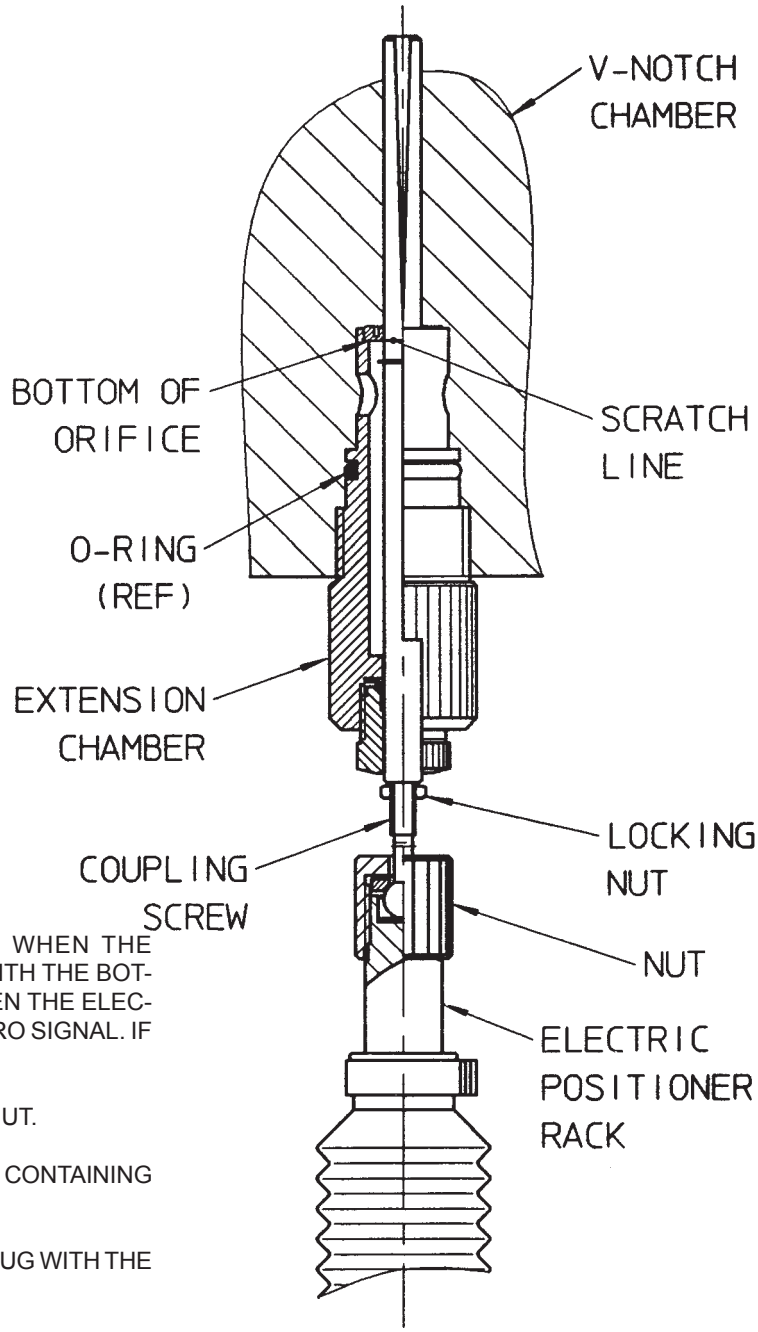
A. LOOSEN PLASTIC NUT AND REMOVE ROTAMETER SHIELD.
B. INSERT THE TOP RING GASKET INTO THE DISTRIBUTOR BLOCK AND THE BOTTOM RING GASKET IN THE COLLAR. APPLY A VERY LIGHT FILM OF HALOCARBON GREASE TO EACH RING GASKET.
C. INSERT THE FLOAT, FLAT GASKET, AND UPPER STOP IN THE ROTAMETER, THEN ENGAGE THE BOTTOM OF THE ROTAMETER IN THE COLLAR.
D. ROTATE THE ROTAMETER RELEASE KNOB COUNTERCLOCKWISE. LINE UP THE TOP OF THE ROTAMETER WITH THE DISTRIBUTOR BLOCK. THEN ROTATE THE ROTAMETER RELEASE KNOB CLOCKWISE.
E. POSITION ROTAMETER SHIELD INTO GROOVE IN THE DISTRIBUTOR BLOCK. SECURE WITH PLASTIC NUT.

TO REMOVE ROTAMETER:

A. ROTATE ROTAMETER RELEASE KNOB COUNTERCLOCKWISE.
B. GRASP TUBE IN BOTH HANDS. PULL TOP OF TUBE TOWARD REAR OF CABINET.
C. LIFT OFF TUBE WITH CARE. DOE NOT DROP LOOSE PARTS.

SERIES V-2000 GAS FEEDER - SERVICE
Installation of Rotameter

25.055.150.020
ISSUE 3 6-97



THE PLUG IS AT THE ZERO POSITION WHEN THE SCRATCH LINE ON THE PLUG IS IN LINE WITH THE BOTTOM OF THE ORIFICE. THIS RESULTS WHEN THE ELECTRONIC CONTROLLER IS RECEIVING A ZERO SIGNAL. IF ADJUSTMENTS ARE NECESSARY:

A. RETRACT RACK AND THEN LOOSEN NUT.

B. UNSCREW THE EXTENSION CHAMBER CONTAINING THE V-NOTCH PLUG AND ORIFICE.

C. LINE UP THE SCRATCH LINE ON THE PLUG WITH THE BOTTOM OF THE ORIFICE.

D. CAREFULLY REINSTALL THE EXTENSION CHAMBER INTO THE UNIT.

E. LOOSEN LOCKING NUT AND SCREW COUPLING SCREW COMPLETELY IN.

F. USE ELECTRICAL SIGNAL FROM CONTROLLER TO POSITION RACK AT ZERO FEED POSITION.

G. ADJUST BALL AND SCREW FOR CORRECT ALIGNMENT BETWEEN THE ACTUATOR AND THE PLUG.

H. ATTACH THE NUT AND TIGHTEN.

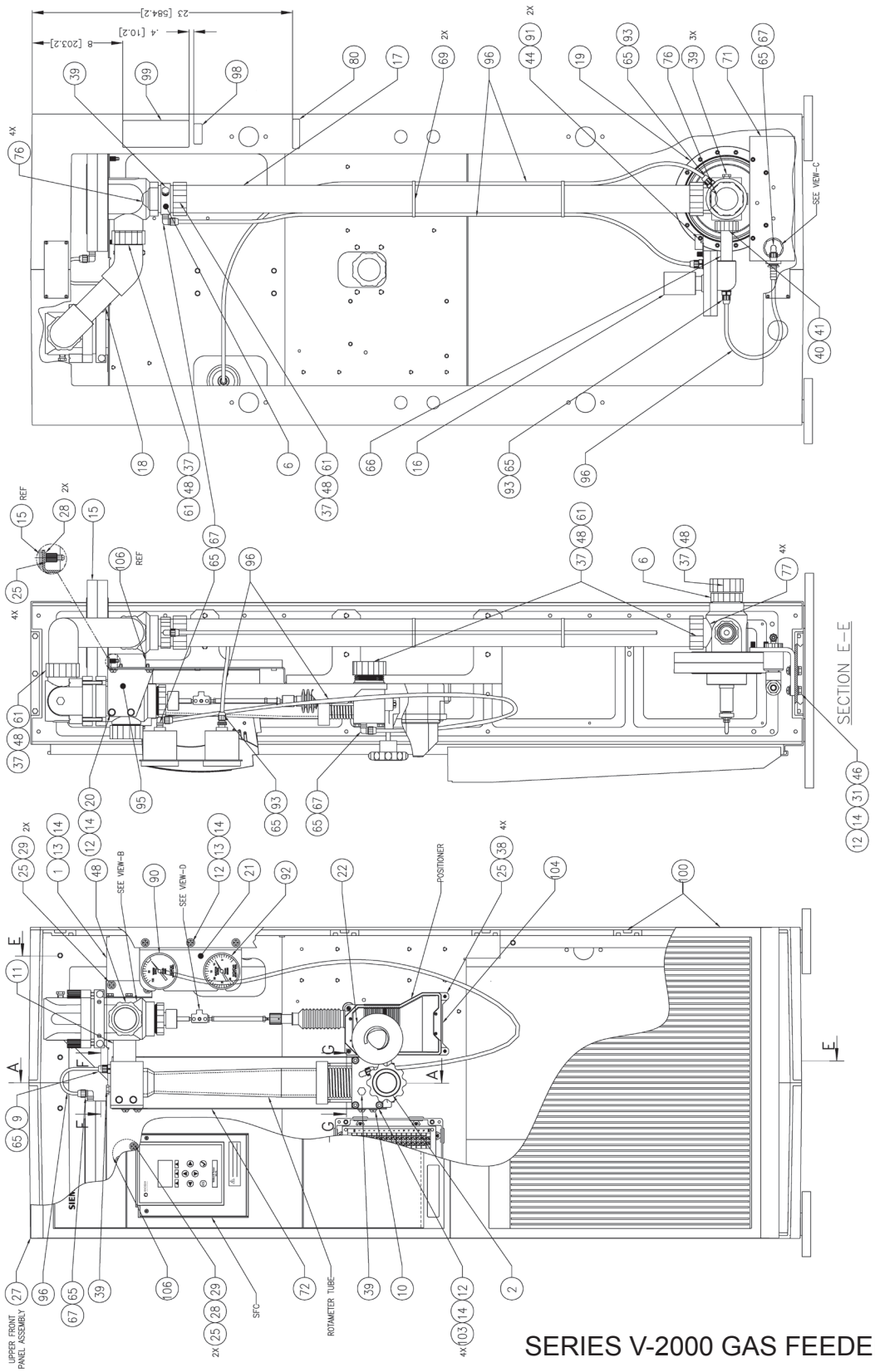
AUTOMATIC CONTROL UNIT - SERVICE
Zero Position of Plug

25.200.150.010
ISSUE 0 10-95

SECTION 5

SECTION 5 - ILLUSTRATIONS

List Of Contents

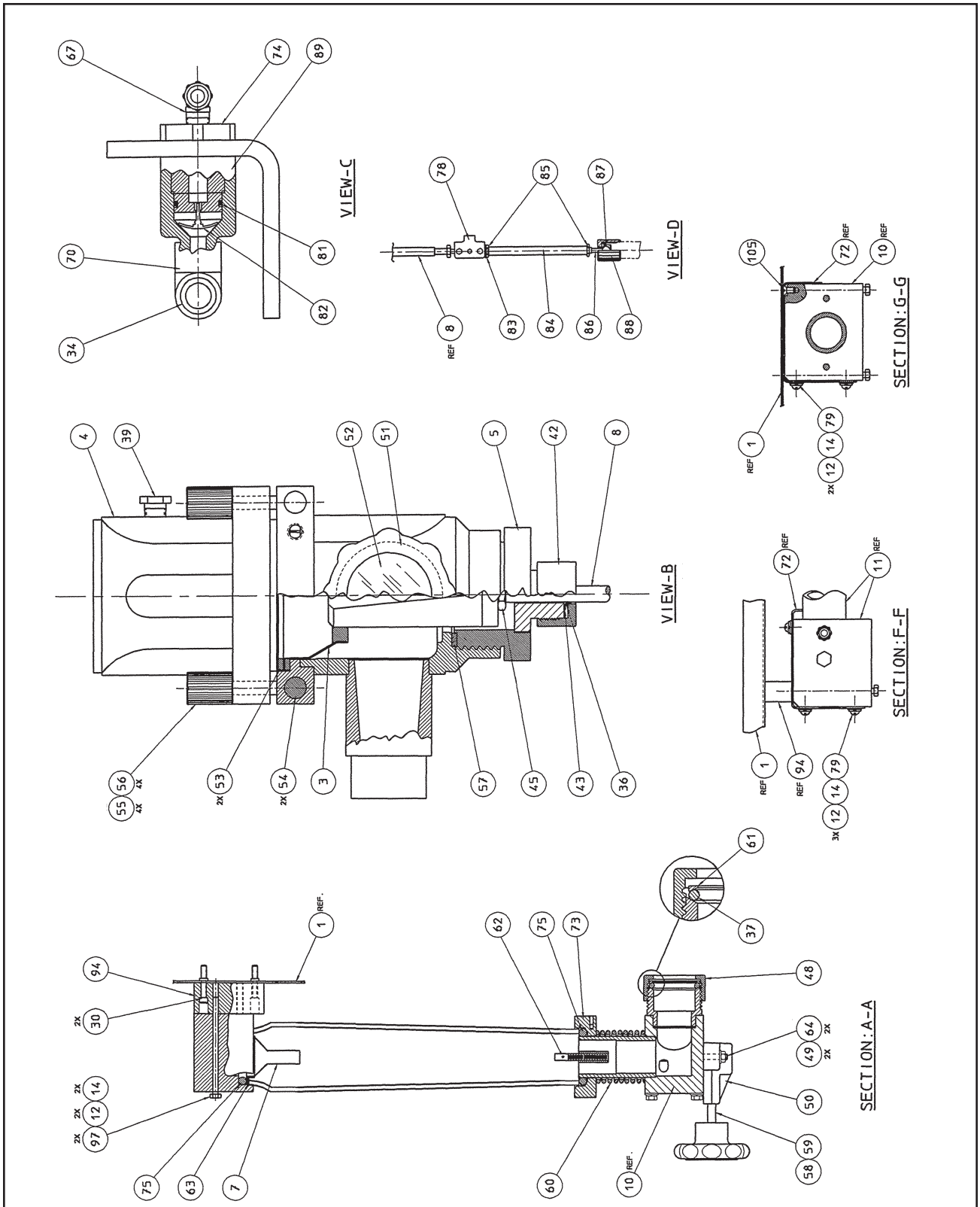


SERIES V-2000 GAS FEEDER - PARTS

25.055.000.032A

ISSUE 3 7-14

NOTE: FOR PARTS LIST, SEE DWGS. 25.055.000.032C,D&E.



SERIES V-2000 GAS FEEDER - PARTS

25.055.000.032B

ISSUE 1 6-02

NOTE: FOR PARTS LIST, SEE DWGS. 25.055.000.032C,D&E.

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	AAA6422	1	BRACKET, MAIN
2	U14815	1	KNOB, ROTAMETER
3	U17366	1	ORIFICE, PLUG
4	U17367	1	CAP, TOP
5	U17370	1	CAP, BOTTOM
6	U17400	2	SEAT
7	U17572	1*	STOP, UPPER FLOAT
8	U18955	1	STEM, PLUG
9	U20902	1	VENTURI UNIT
10	AAA9194	1	HOUSING, INLET, ROTAMETER
11	AAA7112	1	CHAMBER
12	P29713	18	WASHER LOCK, 1/4" S.S.
13	P42901	2	SCREW, MACH., RD. HD. SLOT, #1/4-20 x 3/4"
14	P19888	23	WASHER FL, 1/4" S.S.
15	AAA9518	1	VALVE, DIFF.
16	U28981	1	DRAIN VALVE UNIT
17	AAA9371	1	LINE, DIFF. VALVE/DRAIN
18	AAA9200	1	LINE, DIFF. VALVE/CONN.
19	U28983	1	VALVE, TRIMMER
20	P18279	2	SCREW, HEX HD. CAP 1/4-20 x 1-1/2" LG., S.S.
21	AAA6395	1	PLATE, GAUGE
22	AAA7073	1	DISC, KNOB, POSITIONER
25	P38740	12	WASHER, FLAT, #10, S.S.
26	P16392	1	BAG
28	P13619	4	WASHER, LOCK, #10 S.S.
29	P35117	4	SCREW, MACH., RD. HD. SLOT, #10-24 x 1/2"
30	P43162	2	BOLT, HEX SOC. HD., 1/4-20
31	P19835	4	NUT, HEX 1/4-20
34	P48792	1	ADAPTER
36	PXH26482	1	O-RING, 012 BUNA N
37	P28509	6	O-RING, HYPALON 1-7/8" ID x 2-3/8" OD
38	P44486	4	SCREW, #10-24 x 2-1/4" LG
39	P31295	7	PLUG, 1/4" PIPE
40	P32267	1	O-RING, #318 HYPALON
41	P34485	1	NUT, UNION

NOTE: * ONE OF EACH ITEM CONTAINED IN BAG (ITEM NO. 26).

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

SERIES V-2000 GAS FEEDER - PARTS LIST

25.055.000.032C

ISSUE 2 5-08

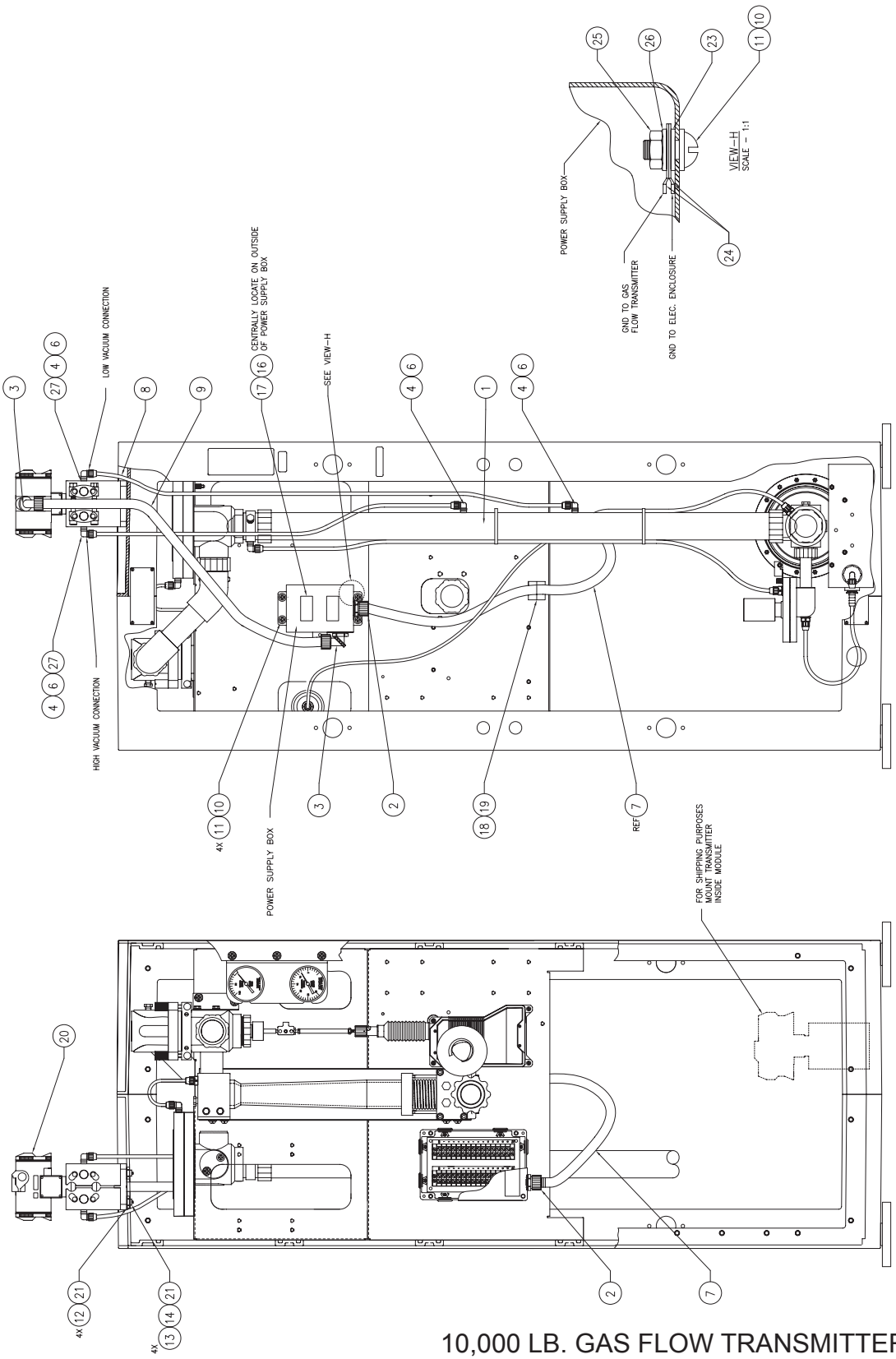
KEY NO.	PART NO.	QTY.	DESCRIPTION
42	P34529	1	NUT, SEAL CLAMP
43	P34530	1	GASKET, PLUG SEAL
44	P34555	2	NUT, PLASTIC, #10-24
45	P35107	1	NUT, HEX, SILVER, 3/8-16
46	P29770	4	BOLT, 1/4-20
48	P36802	7	NUT, UNION, 1-1/2"
49	P36834	2	STUD
50	P36927	1	BRACKET, ROTAMETER
51	P36982	1	GASKET, WINDOW
52	P36983	1	WINDOW
53	P36984	2	GASKET
54	P36985	2	ROD, CLAMP
55	P36986	4	STUD, CLAMP, 5/16-18
56	P36987	4	NUT, CLAMP
57	P36988	1	GASKET, KOROSEAL, 1/8" THICK
58	AAA6470	1	SHAFT, RELEASE
59	P36993	1	ROLLER
60	P37000	1	SPRING, ROTAMETER
61	P37015	5	WASHER, NUT, PVC
62	P37059	1	STOP, BOTTOM
63	P37541	1*	GASKET, KOROSEAL, 1/16" THICK
64	P37578	2	NUT, HEX, 1/4-20
65	P39213	9	NUT, TUBE, 1/4"
66	P54231	1	NIPPLE, 3/4" PIPE
67	P39235	6	ELBOW, 90° PVC, 5/16" OD TUBING
69	P59311	2	TYRAP
70	P42699	1	FITTING, ELBOW, 1/2" NPT, PVC
71	AAA6467	1	BRACKET, MTG
72	AAB1721	1	BRACE, ROTAMETER
73	AAA9104	1	COLLAR, ROTAMETER
74	P59202	1	NUT, VALVE CLAMP
75	P44120	2*	O-RING, HYPALON 1-7/8" ID x 2-5/8" OD
76	P44918	5	GASKET, .030 THICK, TEFLON
77	P47467	4	SPACER
78	U16082	1	CLAMP
79	P29693	4	SCR., RD. HD. SLOT, 1/4-20 x 1/2" LG, S.S.

NOTE: * ONE OF EACH ITEM CONTAINED IN BAG (ITEM NO. 26).

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

KEY NO.	PART NO.	QTY.	DESCRIPTION
80	P54516	1	LABEL
81	P47152	1	O-RING, VITON, #119
82	P60338	1	VALVE, UMBRELLA
83	P34524	1	SCREW, COUPLING
84	AAA7817	1	SPACER, STEM
85	P44567	2	NUT, HEX, 1/4-20
86	P97027	1	BALL AND SCREW
87	P97028	1	DISC
88	P97026	1	NUT, CLAMP
89	P59798	1	BODY, CHECK VALVE
90	U29195	1	GAUGE, 0/100" WATER VAC
91	P59806	1	BRACKET, SUPPORT
92	U29194	1	GAUGE, 0/30" MERCURY VAC
93	P39233	3	UNION, HALF, 1/4" NPT, 5/16" OD TUBING
94	AAA6455	1	SPACER, BLOCK, UPPER
95	AAA6413	1	BRACKET, MTG
96	RP504464	14 FT.	TUBING
97	P42414	2	BOLT, HEX, HD. S.S., 1/4-20 x 4-1/2"
98	L2557	1	LABEL, CAUTION
99	P60168	1	LABEL, WARNING
100	GAA1044	0	PROCEDURE ASSY, 27" MODULE
102	AAA8948	1	MODULE PACKAGING ASSEMBLY
103	AAA9183	4	SCR., HEX HD. CAP., 1/4-20 x 1/4" LG, S.S.
104	P50388	1	SEAL, HOLE, 1/2"
105	P35290	1	SCR., FLAT HD. SLOT, 1/4-20 x 1/2" LG, S.S.
106	AAB1724	1	SPACER, DIFF. VALVE

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



10,000 LB. GAS FLOW TRANSMITTER - PARTS

NOTE: FOR PARTS LIST, SEE DWG. 25.055.000.100B.

25.055.000.100A
ISSUE 1 9-08

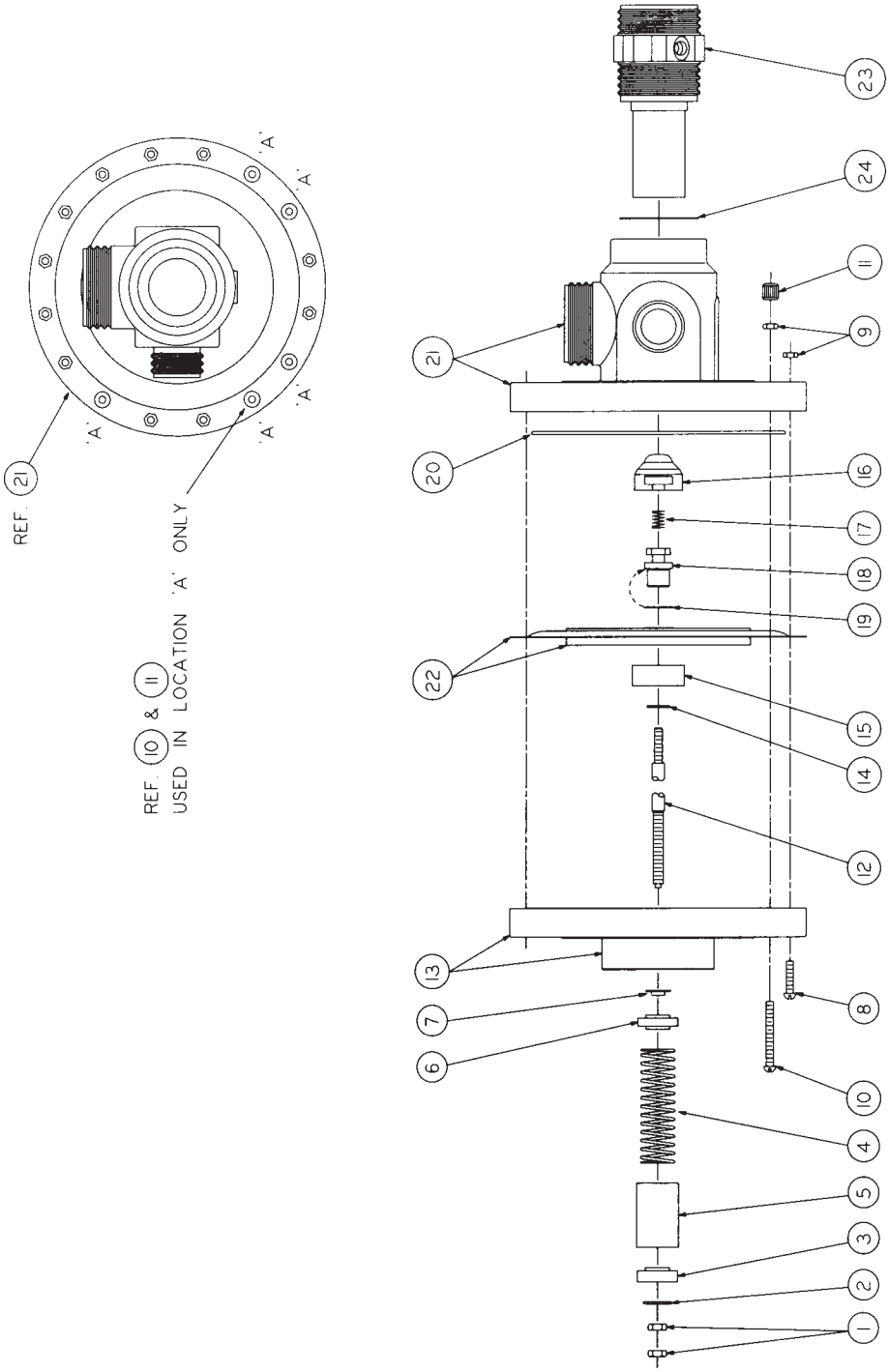
KEY NO.	PART NO.	QTY.	DESCRIPTION
1	AAA7433	1	LINE, ORIFICE
2	AAA7349	2	CONECTOR, STRAIGHT, 3/4"
3	U28019	2	CONNECTOR, SWIVEL
4	P39235	4	ELBOW, HALF UNION
6	P39213	4	NUT, HALF UNION
7	AAA7355	3.25 FT.	CONDUIT, FLEX, 3/4"
8	RP504464	10 FT.	TUBING
9	P58207	3 FT.	CONDUIT, FLEX, 1/2"
10	P19892	5	SCREW, RD. HD. SLOT, 1/4-20 x 5/8" LG., SS
11	P19888	5	WASHER, FLAT, 1/4", SS
12	P40595	4	BOLT, 5/16-18, SS
13	P22617	4	NUT, 5/16-18, SS
14	P15363	4	LOCKWASHER, 5/16", SS
16	L2016	1	LABEL, POWER OFF
17	L1636	1	LABEL, CLOSED COVER
18	P50091	1	TIE MOUNT
19	P41796	1	STRAP, CABLE
20	AAC9473	1	TRANSMITTER
21	P22616	8	WASHER, FLAT, 5/16", SS
23	P29713	1	LOCKWASHER, INTERNAL, 1/4" SS
24	P36492	2	LUG, TERMINAL
25	P44567	1	NUT, HEX, 1/4-20, SS
26	P14635	1	LOCKWASHER, 1/4", SS
27	P35108	2	BUSHING, 1/2" TO 1/4"

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

10,000 LB. GAS FLOW TRANSMITTER - PARTS LIST

25.055.000.100B

ISSUE 1 9-08



NOTE: FOR PARTS LIST, SEE DWG. 25.055.022.010B.

U28983 TRIMMER VALVE - PARTS

25.055.022.010A

ISSUE 2 9-08

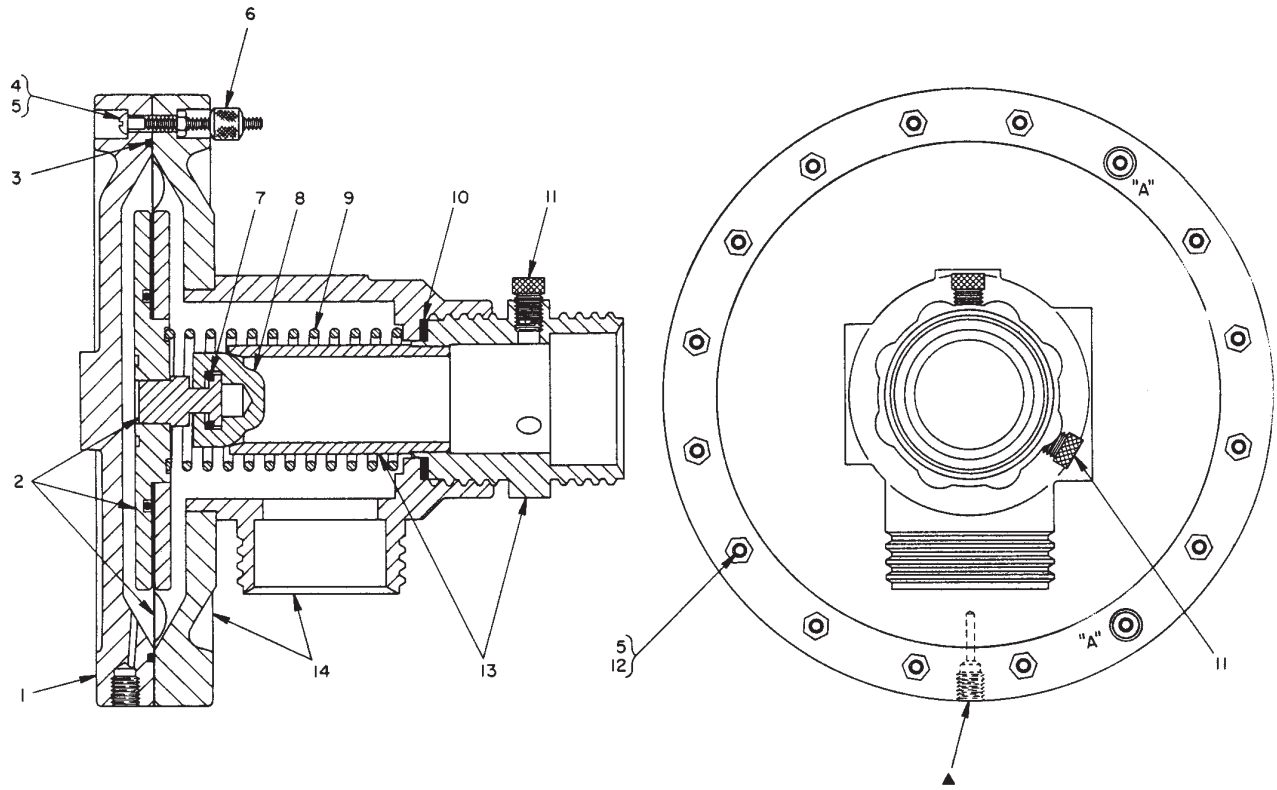
KEY NO.	PART NO.	QTY.	DESCRIPTION
1	P26118	2	NUT, 3/8-16 HEX. BR.
2	PI 8564	1	WASHER, 5/16" FL.MONEL
3	P55504	1	ADAPTER
4	P36969	1	SPRING
5	P37995	1	SPRING, SLEEVE
6	P36968	1	SEAL ADAPTER
7	P34530	1	SHAFT SEAL
8	P35111	11	SCREW 10-24 x 1" LG. RH
9	P35110	16	NUT 10-24
10	P35114	5	SCREW 10-24 x 2" LG. RH
11	P34555	4	NUT, PLASTIC
12	P59812	1	ROD
13	U29106	1	HOUSING
14	PI 6556	1	WASHER, 1/4" FL. MONEL
15	P59813	1	SPACER
16	P42394	1	STEM
17	P36966	1	STEM SPRING
18	P59811	1	STEM
19	P58557	1	GASKET
20	P54865	1	O-RING (170) HYPALON, 7-3/4"ID x 5/16"OD
21	U26783	1	BODY ASSEMBLY
22	U28495	1	DIAPHRAGM ASSEMBLY
▲ 23	U17400	1	SEAT TUBE
▲ 24	P44918	AS REQ'D.	GASKET

NOTE: ▲ NOT PART OF U28983.

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

U28983 TRIMMER VALVE - PARTS LIST

25.055.022.010B
ISSUE 0 5-92



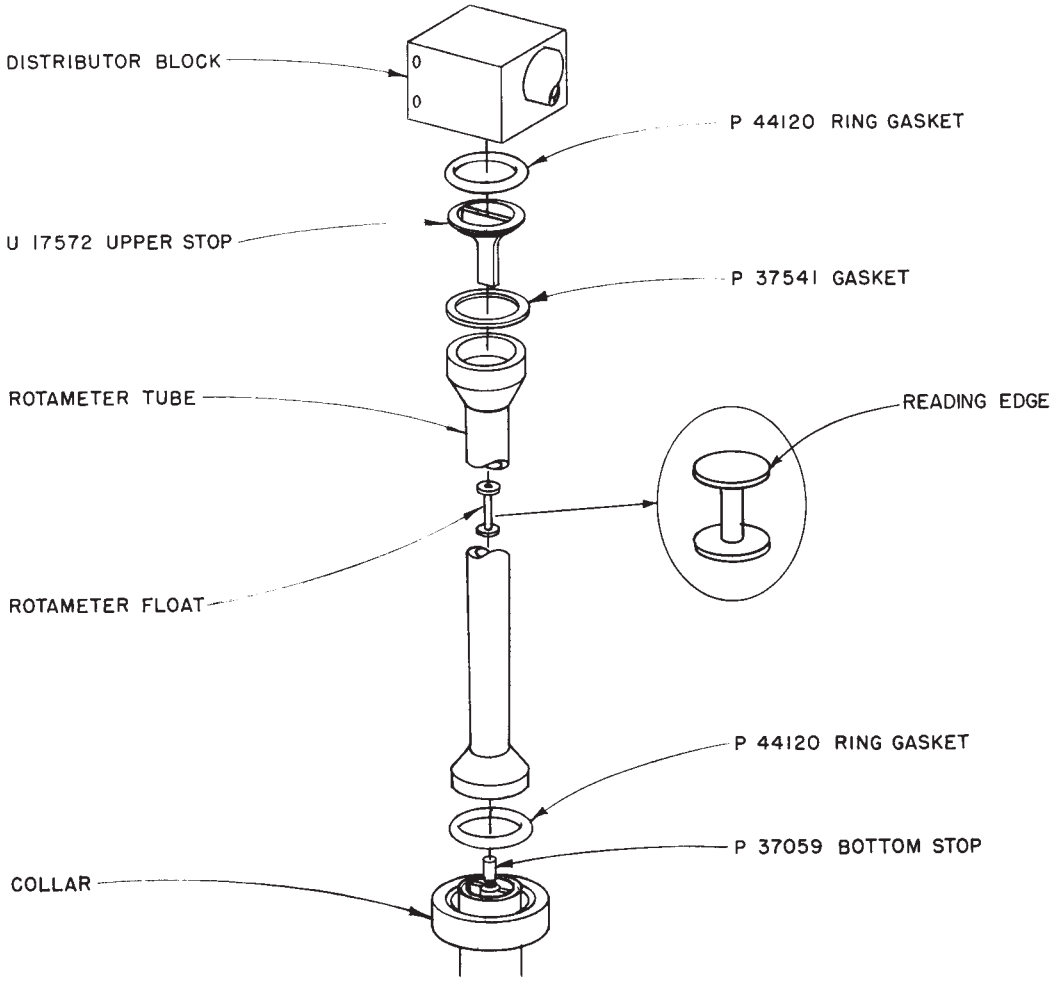
KEY NO.	PART NO.	QTY.	DESCRIPTION
1	P57584	1	UPPER PLATE
2	P17586	1	DIAPHRAGM ASSEMBLY
3	P54865	1	O-RING (170) HYPALON, 7-3/4"ID x 7-15/16"OD
■ 4	P35114	2	MACH. SCREW (RD.HD.,MONEL) #10-24 x 2" LG
5	P35110	16	HEX, NUT (SS) #10-24
■ 6	P34555	2	PLASTIC NUT #10-24
7	PXA27409	1	O-RING (113) VITON, 19/16"ID x 3/4"OD
8	P42394	8	STEM
9	P36952	1	SPRING
● 10	P44918	8	GASKET (AS REQUIRED, 8 MAXIMUM)
● 11	P31295	2	PIPE PLUG (PVC) 1/4" NPT
12	P35111	14	MACH. SCREW (RD.HD.,MONEL) #10-24 x 1"LG
● 13	U17400	1	SEAT TUBE
14	U26799	1	BODY ASSEMBLY

NOTE: ● NOT PART OF AAA9518.
■ POSITION OF KEY NO. 6 INDICATED BY "A".
▲ TAPPED HOLE IN KEY NO. 1 MUST BE IN POSITION SHOWN.

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

AAA9518 DIFFERENTIAL VALVE - PARTS
Used in 10,000 Lb. Series V-2000 Gas Feeder

25.055.017.020
ISSUE 0 8-02

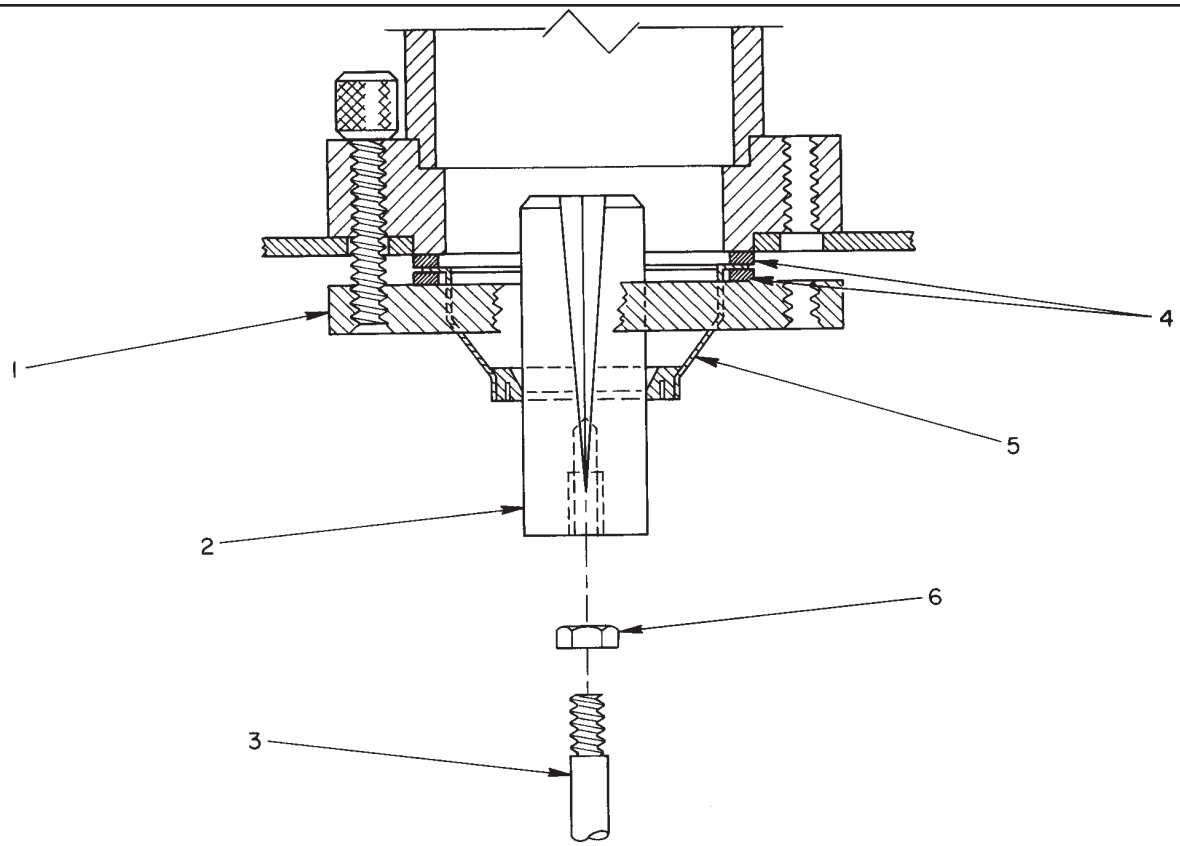


MAX. CAPACITY lbs/day	ROTAMETER			MAX. CAPACITY kg/day	ROTAMETER		
	COMPLETE TUBE & FLOAT UNIT	TUBE	FLOAT		COMPLETE TUBE & FLOAT UNIT	TUBE	FLOAT
1,000	UXA 20946	P 44080	U 18268	450	UXA21413	PXG44080	U18268
2,000	UXB 20946	P 44081	U 17952	900	UXB21413	PXG44081	U17952
3,000	UXC 20946	P 44082	U 18033	1350	UXC21413	PXG44082	U18033
4,000	UXD 20946	P 44083	U 17954	1800	UXD21413	PXG44083	U17954
5,000	UXE 20946	P 44084	U 18428	2250	UXE21413	PXG44084	U18428
6,000	UXF 20946	P 44085	U 18034	2700	UXF21413	PXG44085	U18034
8,000	UXG 20946	P 44086	U 17956	3600	UXG21413	PXG44086	U17956
10,000	UXH 20946	P 44087	U 17958	4500	UXH21413	PXG44087	U17958

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

10,000 LB. SERIES V-2000 CHLORINATOR - PARTS
Chlorine Rotameter Components

25.055.002.030
ISSUE 2 4-05

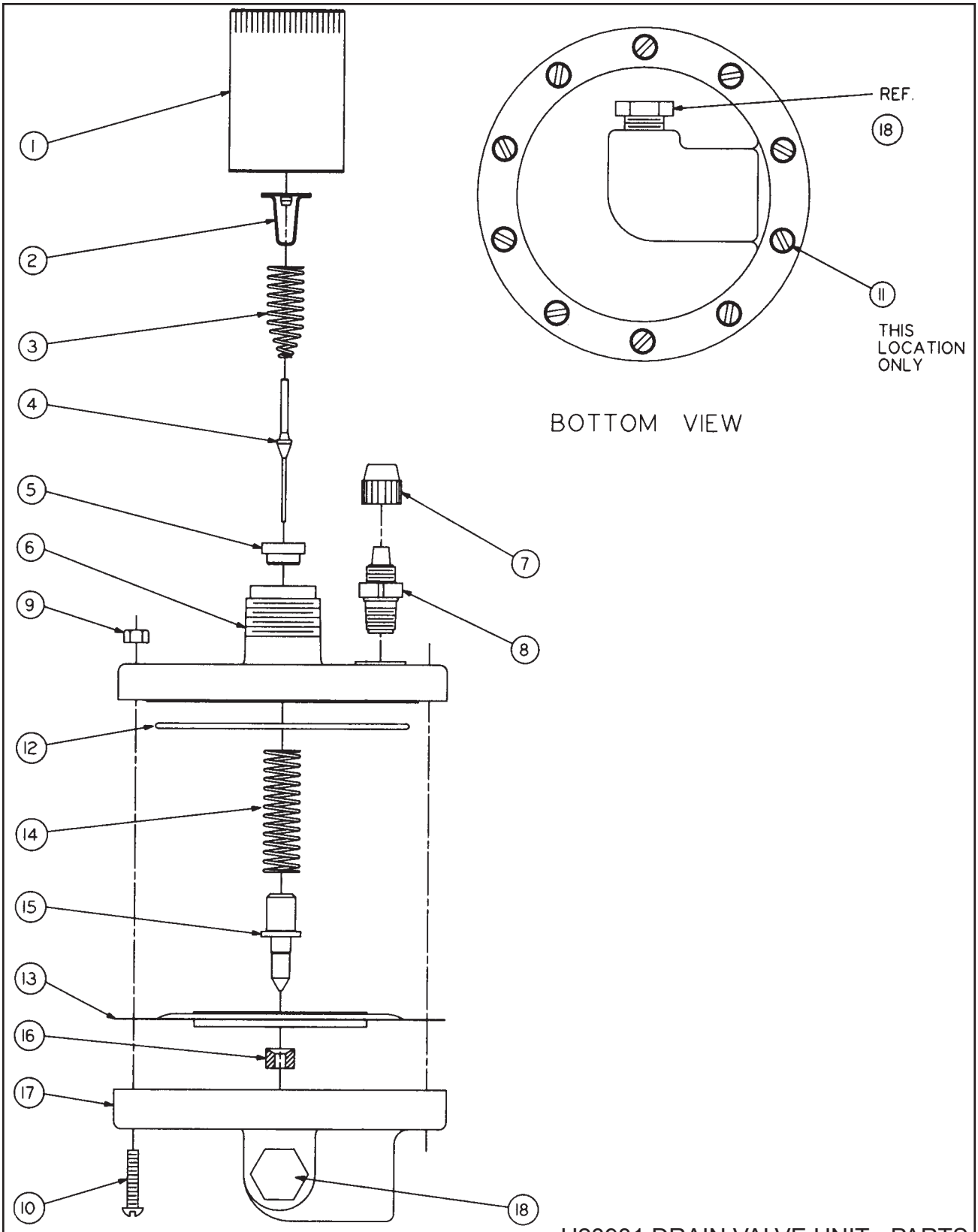


KEY NO.	PART NO.	QTY.	DESCRIPTION
1	P 36985	2	1/4" CLAMPING ROD (BRASS)
2	---	1	V-NOTCH PLUG (SEE TABLE BELOW)
3	---	1	V-NOTCH PLUG STEM (SEE TABLE BELOW)
4	P 36984	2	GASKET
5	---	1	ORIFICE (SEE TABLE BELOW)
6	P 35107	1	1/4" LOCK NUT (SILVER)

CAP. PER 24 HRS	V-NOTCH PLUG			
	MANUAL (LOG)	ELECTRIC (LINEAR)	ORIFICE	V-NOTCH PLUG SYSTEM
1,000	PXA39604 (AK)	PXA39597 (F)	U17366	U18955
2,000	PXA39604 (AK)	PXB39597 (G)	U17366	U18955
3,000	PXA39604 (AK)	PXC39597 (H)	U17366	U18955
4,000	PXB39604 (AL)	PXD39597 (J)	U17366	U18955
5,000	PXB39604 (AL)	PXE39597 (K)	U17366	U18955
6,000	PXB39604 (AL)	PXF39597 (L)	U17366	U18955
8,000	PXB39604 (AL)	PXG39597 (M)	U17366	U18955
10,000	PXB39604 (AL)	PXH39597 (N)	U17366	U18955

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

CHLORINE V-NOTCH PLUG COMPONENTS - PARTS
Used in 10,000 Lb. Series V-2000 Chlorinator
25.055.001.065
ISSUE 2 5-08



U28981 DRAIN VALVE UNIT - PARTS

NOTE: FOR PARTS LIST, SEE DWG. 25.055.021.010B.

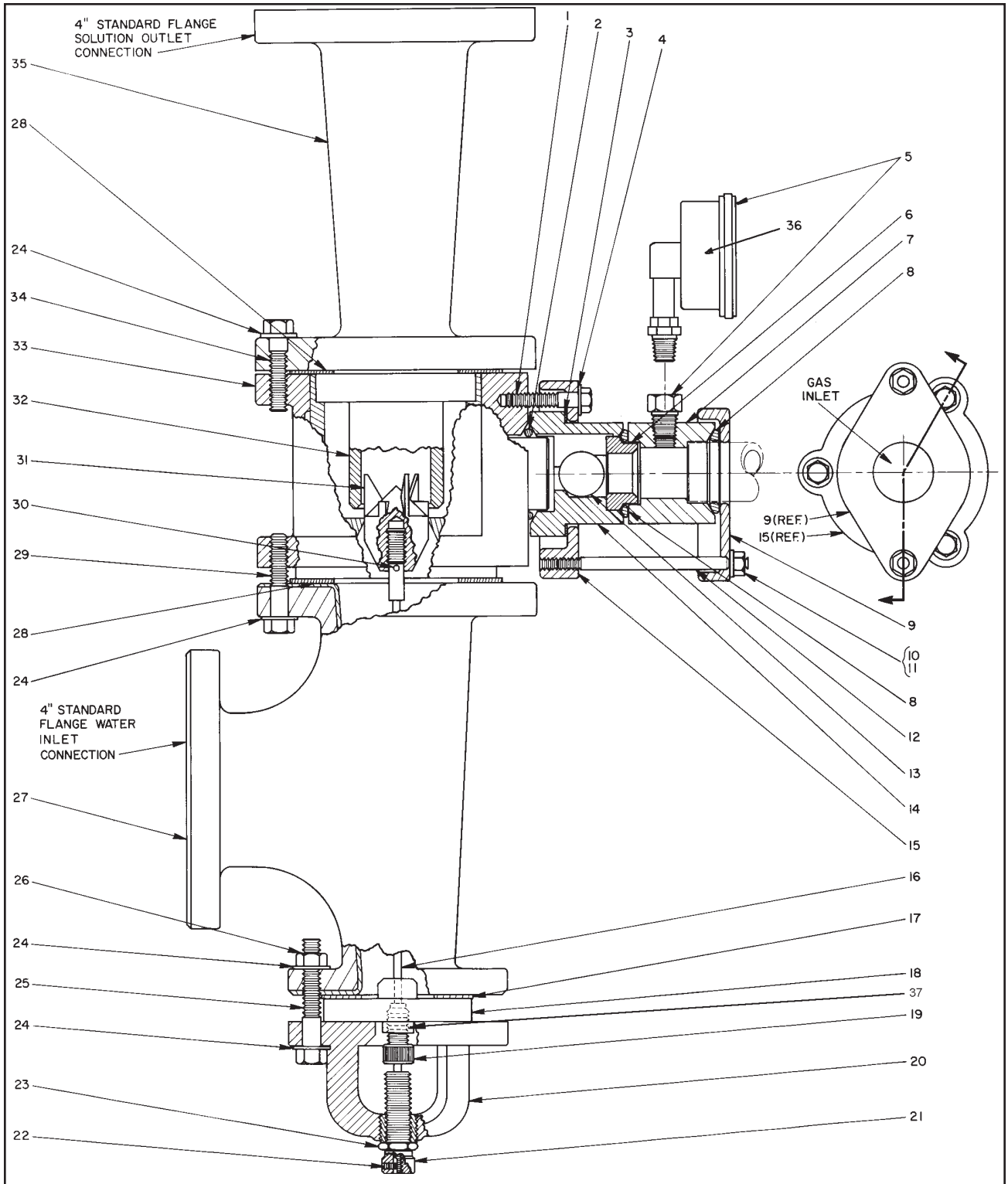
25.055.021.010A
ISSUE 0 5-92

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	P59801	1	CAP, DIFF. DRAIN VALVE
2	U25890	1	GUIDE RETAINER
3	P48329	1	SPRING, COMPRESSION, HAST. C
4	U25891	1	STEM UNIT
5	P59797	1	SEAT, TEFLON
6	U28979	1	HOUSING, DRAIN
7	P39213	1	NUT, 5/16" TUBE
8	P39233	1	UNION, HALF 3/8"OD TUBING
9	P35110	10	NUT, 10-24 HEX SS
10	P35111	9	SCREW 10-24 x 1" RH. MON.
11	P35112	1	SCREW 10-24 x 1-1/2" RH. MON.
12	P50286	1	O-RING (156) HYPALON, 4-1/4"ID x 4-7/16"OD
13	U26705	1	DIAPHRAGM UNIT
14	P39725	1	SPRING, COMPRESSION, HAST. C
15	P59799	1	STEM, PVC
16	P34766	1	SEAT, TEFLON
17	P35036	1	HOUSING, OUTLET
18	P43466	1	PLUG, 1/2" PIPE PVC

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

U28981 DRAIN VALVE UNIT - PARTS LIST

25.055.021.010B
ISSUE 0 5-92



NOTE: FOR PARTS LIST, SEE DWG. 25.130.006.032B.

A757021 4" INJECTOR - PARTS

25.130.006.032A
ISSUE 1 4-05

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	PC8449	3	CAP SCREW CHEX.HD.,STEEL) 1/2"-13 x 2-1/4" LG.
2	P38497	1	RING GASKET
3	FP 238	1	GASKET
4	PC33262	3	1/2" WASHER
5	P43466	1	1/2" PIPE PLUG (PVC)
	OR		
▲	U26666	1	VACUUM PRESSURE GAUGE & DIAPHRAGM
6	P38468	1	BALL CHECK SEAT
7	P38463	1	SUCTION BLOCK
8	P38495	2	RING GASKET
9	P58506	1	FLANGE CLAMP
10	PC1090	2	3/8" WASHER (STEEL)
11	PC888	2	HEX. NUT (3/8-16)
12	P38467	2	STUD
13	P38506	1	1-1/2" DIA. BALL (TEFLON)
14	P38478	1	BALL CHECK HOUSING
15	P58508	1	CLAMPING PLATE
16	P18101	1	ROD UNIT
17	P24221	1	RING GASKET
18	P55867	1	PACKING BUSHING PLATE
19	P37486	1	PACKING NUT
20	P28156	1	YOKE UNIT
21	P37487	1	ADJUSTING NUT
22	PC9877	1	SET SCREW (STEEL) 10-32 x 1/4" LG.
23	P37483	1	LOCK NUT
24	P23595	24	5/8" WASHER (S.S)
25	PC11348	4	CAP SCREW (HEX.HD.,STEEL) 5/8"-11 x 3-1/2" LG.
26	PC890	4	HEX. NUT (5/8-11) STEEL
27	P58509	1	FLANGED REDUCING TEE
28	P24223	2	RING GASKET
29	PC12290	8	CAP SCREW (HEX.HD.,STEEL) 5/8"-11 x 2-3/4"
30	P38477	1	PIN
31	P43619	1	PLUG
32	U18369	1	THROAT EXIT TUBE
33	U28157	1	THROAT HOUSING
34	PC21386	8	CAP SCREW (HEX.HD.,STEEL) 5/8"-11 x 2-1/2" LG.
35	P58507	1	TAILWAY
36	L2076	1	CAUTION LABEL (PART OF KEY NO. 5, U26666)
37	P19369	1	PACKING (3" REQUIRED, SOLD BY THE FOOT)

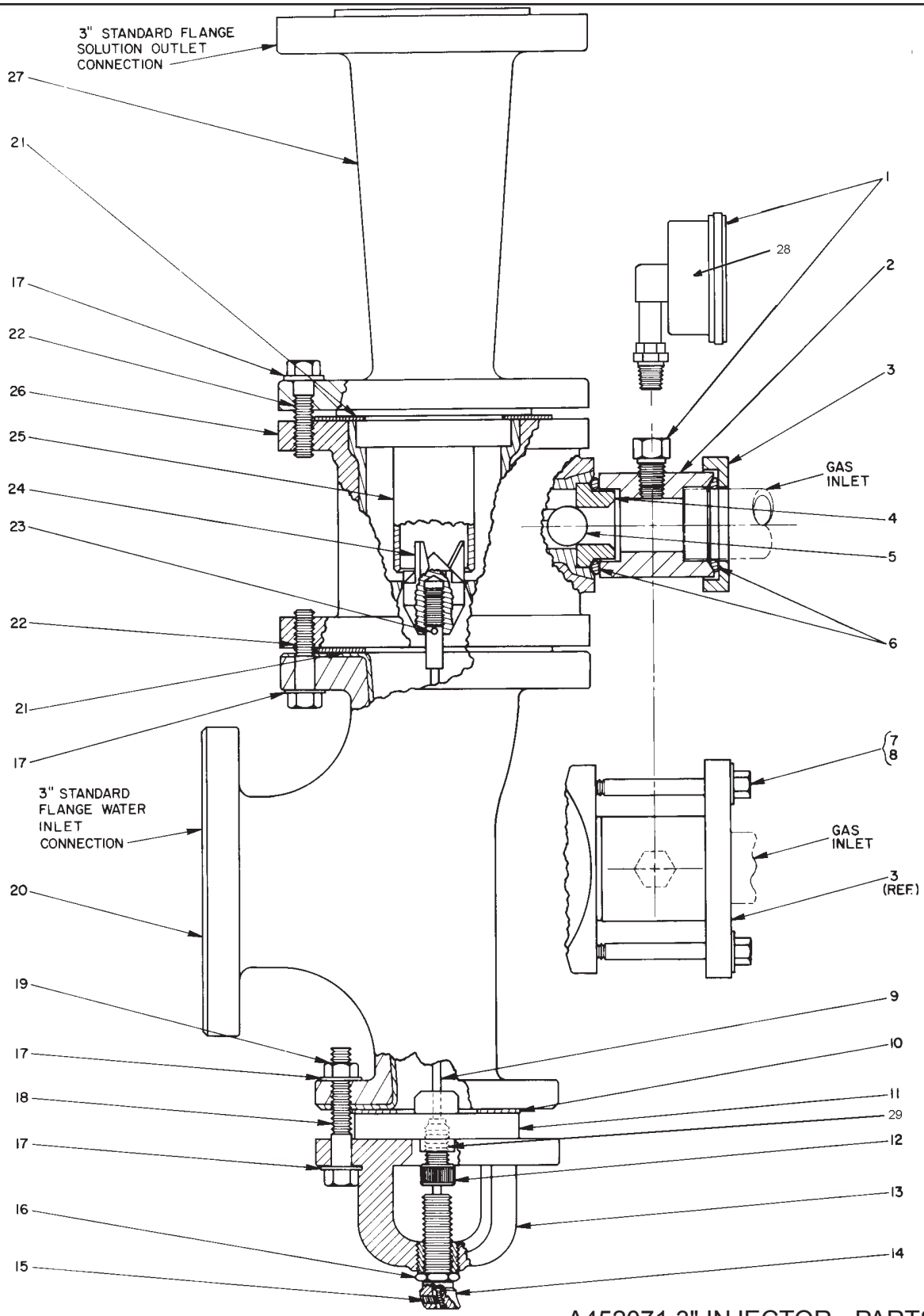
NOTE: ▲ ACCESSORY ITEM FURNISHED ONLY IF SPECIFICALLY LISTED IN QUOTATION.

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

A757021 4" INJECTOR - PARTS LIST

25.130.006.032B

ISSUE 1 4-05



A452071 3" INJECTOR - PARTS
25.130.006.023A
ISSUE 1 4-05

NOTE: FOR PARTS LIST, SEE DWG. 25.130.006.023B.

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	P43466	1	1/2" PIPE PLUG (PVC)
	OR		
▲	U26666	1	VACUUM PRESSURE GAUGE & DIAPHRAGM
2	P37528	1	INLET PIPE HOUSING
3	P58504	1	OUTER CLAMP
4	P51277	1	BALL CHECK SEAT
5	P51111	1	1" DIA BALL (TEFLON)
6	P12285	2	RING GASKET
7	P32943	2	CAP SCREW (HEX.HD.,STEEL) 3/8"-16 x 4" LG.
8	P4955	2	3/8" WASHER (BRASS)
9	P18248	1	ROD UNIT
10	P12286	1	GASKET
11	P55864	1	PACKING BUSHING PLATE
12	P37486	1	PACKING NUT
13	U28153	1	YOKE UNIT
14	P37487	1	ADJUSTING NUT
15	P9877	1	SET SCREW (STEEL) 10-32 x 1/4" LG.
16	P37483	1	LOCK NUT
17	P23595	16	5/8" WASHER (S.S.)
18	P11348	4	CAP SCREW (HEX.HD.,STEEL) 5/8"-11 x 3-1/2" LG.
19	P890	4	HEX. NUT (5/8"-11) STEEL
20	P58503	1	REDUCING TEE
21	P24222	2	RING GASKET
22	P12289	8	CAP SCREW (HEX.HD.,STEEL) 5/8"-11 x 2" LG.
23	P37504	1	PIN
24	P40911	1	PLUG
25	U18250	1	THROAT EXIT UNIT
26	U28154	1	THROAT HOUSING
27	U28155	1	TAILWAY
28	L2076	1	CAUTION LABEL (PART OF KEY NO. 1, U26666)
29	P19369	1	PACKING (SOLD BY THE FOOT, 3" REQUIRED)

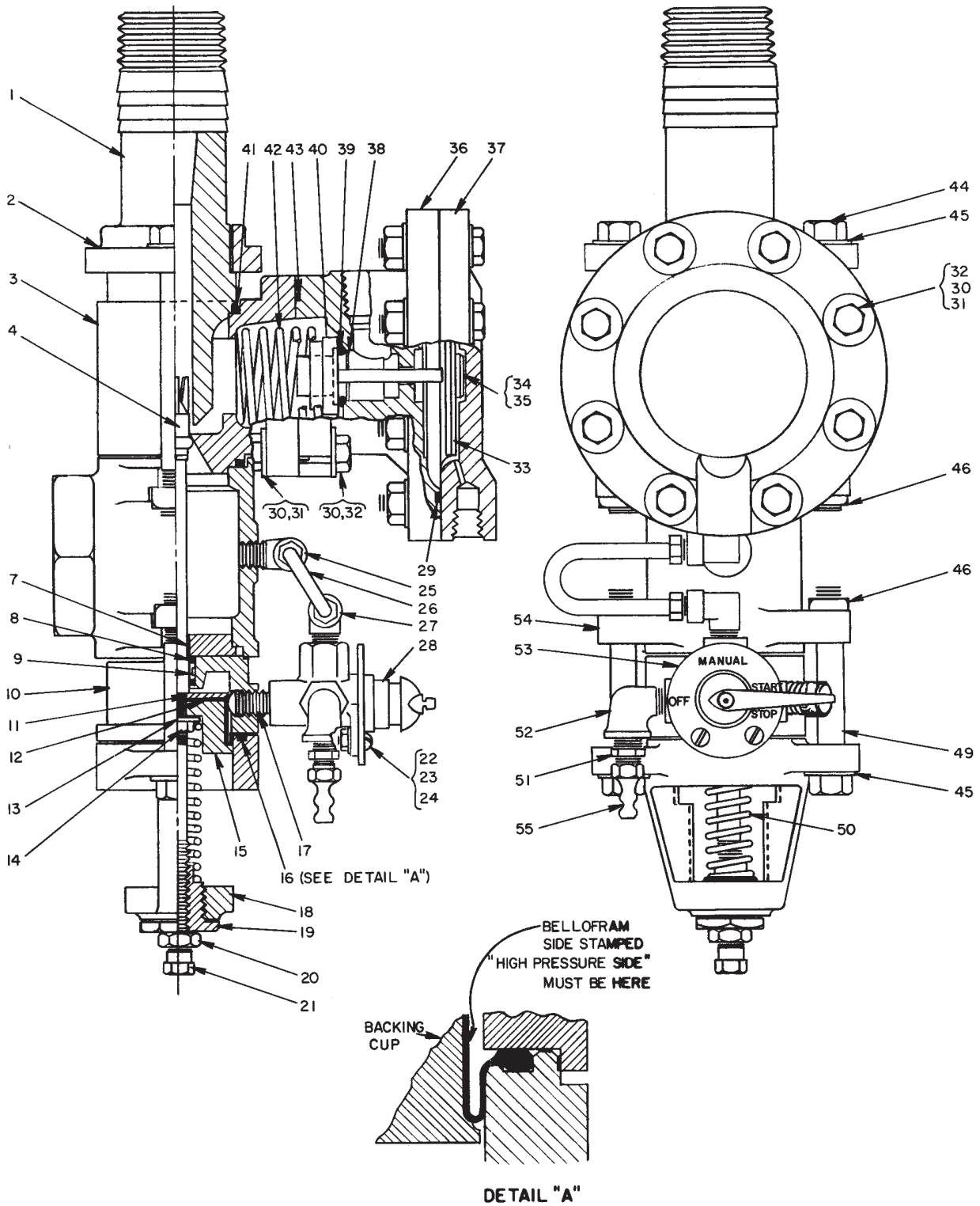
NOTE: ▲ ACCESSORY ITEM FURNISHED ONLY IF SPECIFICALLY LISTED IN QUOTATION.

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

A452071 3" INJECTOR - PARTS LIST

25.130.006.023B

ISSUE 1 4-05



NOTE: FOR PARTS LIST, SEE DWG. 25.052.001.046B.

U25762 SMALL THROAT; U25763 LARGE THROAT

2" INJECTOR - PARTS

With Pressure-Operated Plug Shut-Off

25.052.001.046A

ISSUE 5 4-05

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	PXA40550	1	TAILWAY - LARGE THROAT (USED IN U25763)
	OR		
	PXA40549	1	TAILWAY - SMALL THROAT (USED IN U25762)
2	P34569	1	FLANGE
3	PXA40554	1	THROAT - LARGE (USED IN U25763)
	OR		
	PXA40553	1	THROAT - SMALL (USED IN U25762)
4	AAC5921	1	PLUG - LARGE (USED IN U25763)
	OR		
	AAC5918	1	PLUG - SMALL (USED IN U25762)
7	P42260	1	DISC - O-RING
8	P31702	2	O-RING (110) BUNA-N, 3/8"ID x 9/16"OD
9	P42259	1	LANTERN RING
10	P42258	1	DIAPHRAGM BODY
11	PXA34572	1	BACKING WASHER
12	P26234	1	O-RING (011) BUNA-N, 5/16"ID x 7/16"OD
13	P22616	1	5/16" WASHER (S.S.)
14	P26118	1	HEX. NUT (S.S.) 5/16"-18
15	P36610	1	BACKING CUP
16	P34567	1	BELLOFRAM
17	P 629	1	CLOSE NIPPLE 1/4" NPT (BRASS)
18	PXA40563	1	BELLOFRAM YOKE
19	P40572	1	ADJUSTING SCREW NUT
20	PN18680	1	HEX. NUT (BRASS) 1/2"-13
21	P40573	1	ADJUSTING SCREW
22	PE28283	2	MACH.SCREW (RD.HD.,BRASS)#10-24 x 1/2"LG.
23	PE5663	2	#10 WASHER (BRASS)
24	PE14725	2	HEX. NUT (BRASS) #10-24
25	U19347	1	ELBOW WITH SCREEN
26	P40574	1	1/4" CONNECTING TUBE
27	U16096	1	ELBOW 1/4" TUBE x 1/4" NPT (BRASS)
28	U16435	1	SELECTOR VALVE
29	P50286	1	RING GASKET
30	P38100	24	3/8" WASHER (MONEL)
31	P16543	12	HEX. NUT (MONEL) 3/8-16
32	P17649	12	BOLT (HEX.HD.,MONEL) 3/8-16 x 1-3/4"LG.
33	U17639	1	DIAPHRAGM UNIT
34	P37641	1	PLUG
35	P33051	1	O-RING (009) BUNA-N, 7/32"ID x 11/32"OD
36	P53374	1	BODY
37	P40555	1	COVER
38	P47225	1	STEM
39	AAC7568	1	O-RING (KALREZ), 3/4"ID x 1"OD
40	U20580	1	STEM & POST UNIT
41	P41329	3	O-RING (228) BUNA-N, 2-1/4"ID x 2-1/2"OD
42	P40571	1	SPRING
43	P40578	1	O-RING (148) BUNA-N, 2-3/4"ID x 2-15/16"OD
44	PB40576	2	BOLT (HEX.HD.,STEEL) 1/2-13 x 5" LG.
45	PB33262	4	1/2" WASHER (STEEL)
46	PB17493	4	SQUARE NUT (STEEL) 1/2-13
49	PB21381	2	BOLT (HEX.HD.,STEEL) 1/2"-13 x 3-1/2"LG.
50	P34566	1	SPRING
51	P686	1	BUSHING 1/4"NPT x 1/8"NPT (BRASS)
52	P698	1	STREET ELBOW 1/4" NPT (BRASS)
53	P40633	1	INDICATOR PLATE
54	P40556	1	INLET (BRONZE)
55	P500	1	ADAPTER 1/8"NPT TO 1/4"HOSE (BRASS)

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

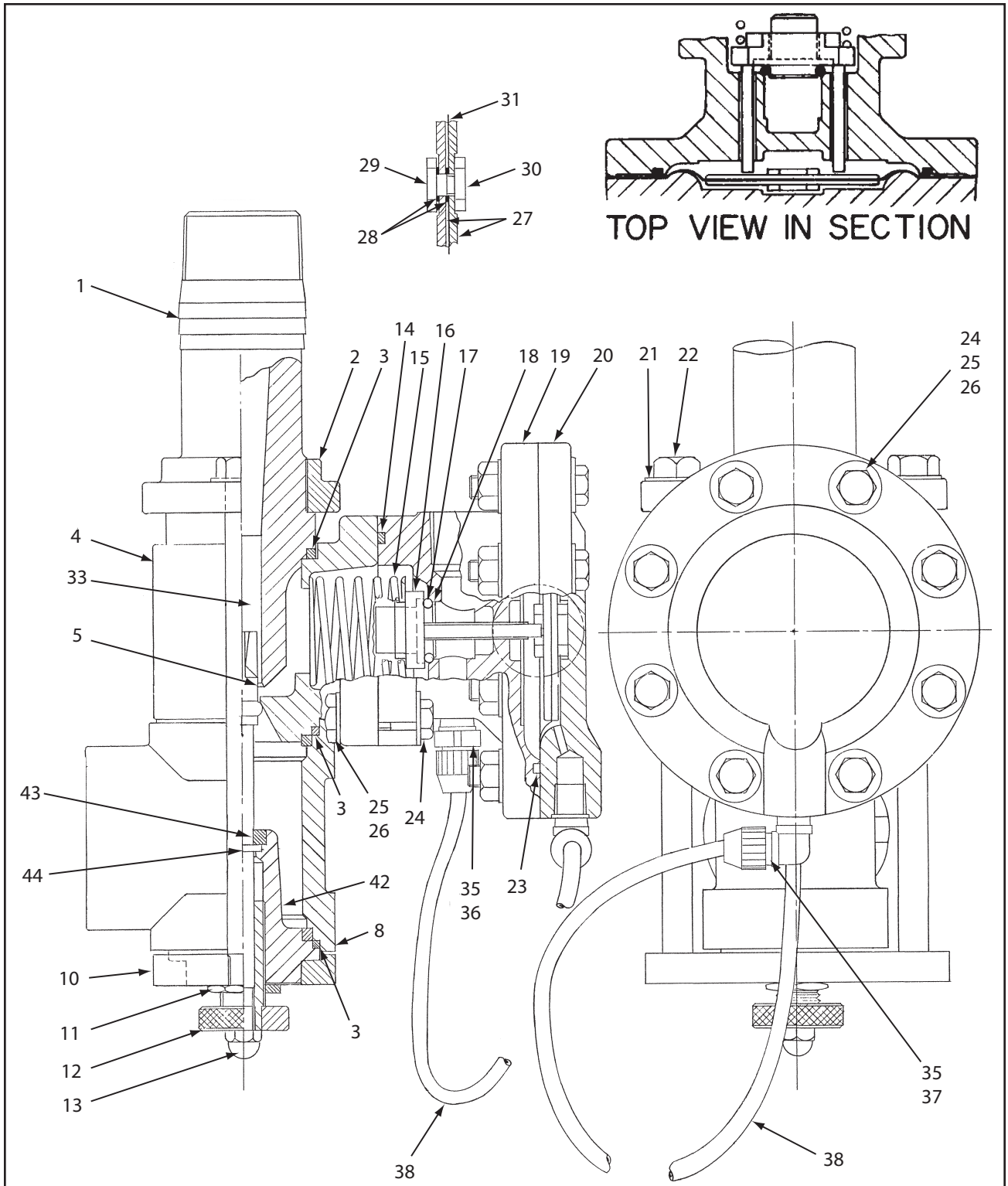
U25762 SMALL THROAT; U25763 LARGE THROAT

2" INJECTOR - PARTS LIST

With Pressure-Operated Plug Shut-Off

25.052.001.046B

ISSUE 8 7-05



NOTE: FOR PARTS LIST, SEE DWG. 25.052.001.051B.

U25764 SMALL THROAT; U25765 LARGE THROAT

2" INJECTOR - PARTS

With Manually Operated Plug Shut-Off

25.052.001.051A

ISSUE 9 7-05

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	PXA40549	1	TAILWAY - SMALL THROAT - USED IN U25764
	OR		
	PXA40550	1	TAILWAY - LARGE THROAT - USED IN U25765
2	P34569	1	FLANGE
3	P41329	3	O-RING (228), BUNA-N, 2-1/4"ID x 2-1/2"OD
4	PXA40553	1	SMALL THROAT - USED IN U25764
	OR		
	PXA40554	1	LARGE THROAT - USED IN U25765
5	AAC5921	1	PLUG ASSY - SMALL THROAT - USED IN U25764
	OR		
	AAC5918	1	PLUG ASSY - LARGE THROAT - USED IN U25765
8	U22163	1	TEE INLET
10	P40893	1	PLATE
11	P10619	1	HEX NUT (BRASS) 3/4"-16
12	U19319	1	KNOB
13	PN5873	1	CAP NUT (BRASS) 5/16"-18
14	P40578	1	O-RING (148), BUNA-N, 2-3/4"ID x 2-15/16"OD
15	P40571	1	SPRING
16	U20580	1	STEM HOLDER & POST
17	AAC7568	1	O-RING (KALREZ), 3/4"ID x 1"OD
18	P47225	1	STEM
19	P53374	1	INLET BODY
20	P40555	1	COVER
21	PB33262	2	1/2" WASHER (BRASS)
22	PB6686	2	HEX. NUT (BRASS) 1/2-13
23	P50286	1	RING GASKET
24	P17649	12	BOLT (HEX.HD.,MONEL) 3/8-16 x 1-3/4" LG.
25	P38100	24	3/8" WASHER (MONEL)
26	P16543	12	HEX. NUT (MONEL) 3/8-16
27	P34488	2	DISC BACKING
28	P34487	2	GASKET SEAL
29	P43132	1	DIAPHRAGM SCREW
30	P43133	1	DIAPHRAGM NUT
31	P43717	1	DIAPHRAGM
33	P40892	2	STUD
35	P39213	2	UNION NUT
36	P39233	1	HALF UNION STRAIGHT
37	P39235	1	HALF UNION ELBOW
38	RP504464	2	TUBING
42	U20100	1	PACKING GLAND 2" INJECTOR
■ 43	P42341	1	O-RING RETAINER
■ 44	P31702	1	O-RING

NOTE: ■ PART OF KEY NO. 42.

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

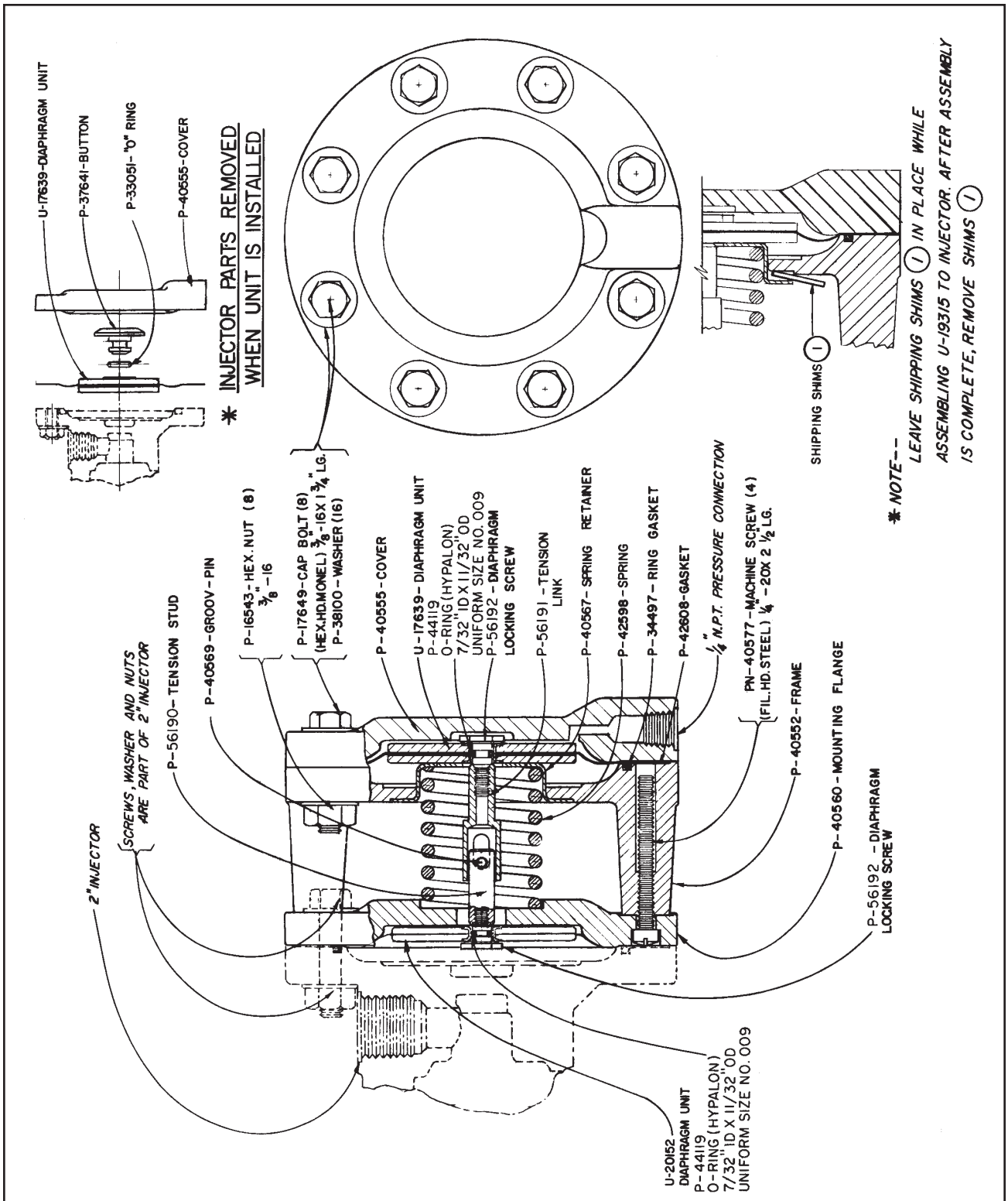
U25764 SMALL THROAT; U25765 LARGE THROAT

2" INJECTOR - PARTS LIST

With Manually Operated Plug Shut-Off

25.052.001.051B

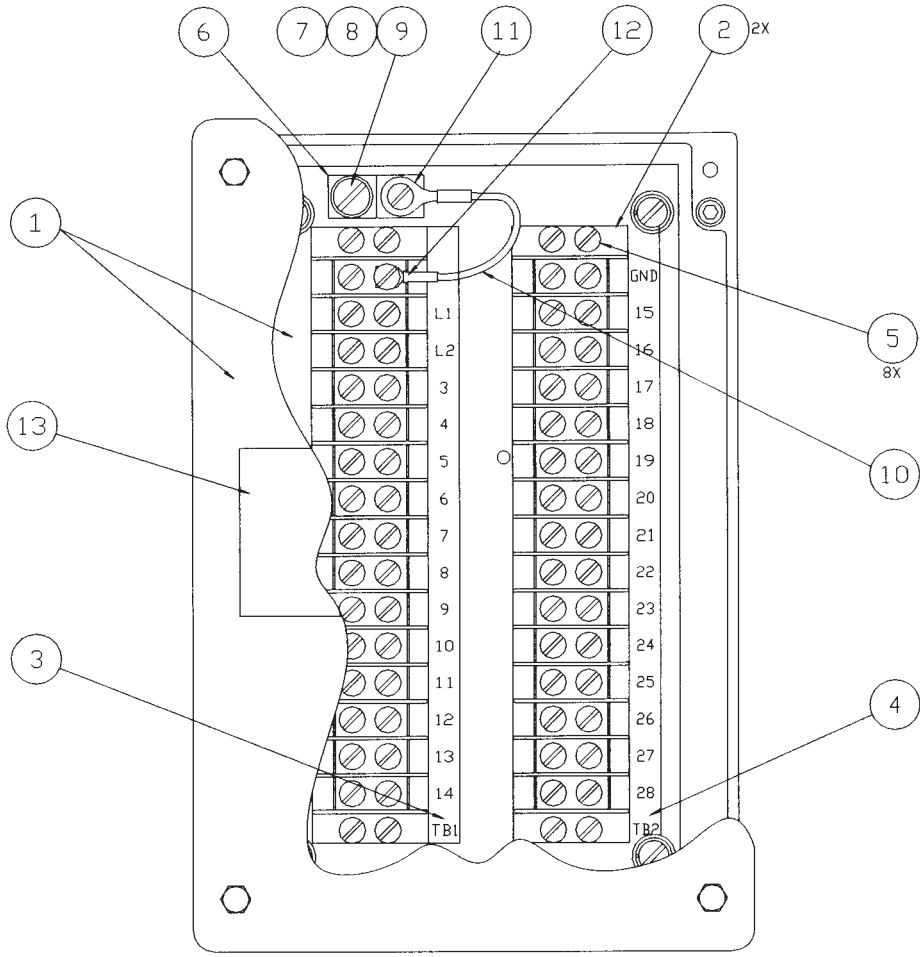
ISSUE 2 7-05



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

U19315 INJECTOR SHUT-OFF UNIT - PARTS

25.100.06.111
ISSUE 6 2-93



NOTE: FOR PARTS LIST, SEE DWG. 25.055.000.017B.

JUNCTION BOX - PARTS

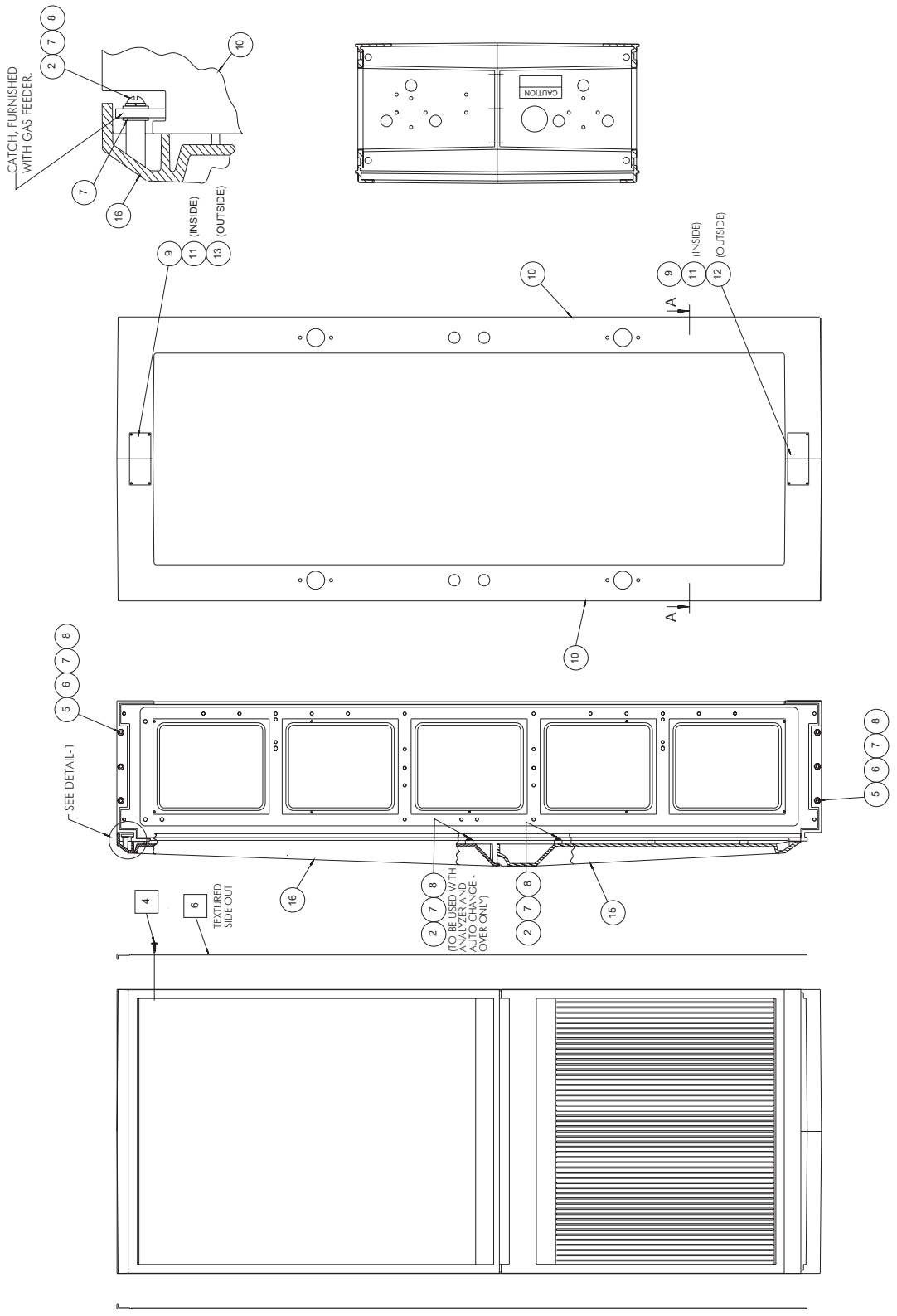
25.055.000.017A
ISSUE 0 6-97

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	AAA9074	1	ENCLOSURE AND PANEL DETAIL
2	U25987	2	TERMINAL BLOCK
3	AAB1403	1	MARKER STRIP
4	P60178	1	MARKER STRIP
5	P43733	8	6-32 x 5/8" LG. SCREW
6	P50450	1	GROUND CONNECTION
7	P18102	1	1/4" MONEL WASHER, LK
8	P29693	1	SCREW, MACH., RD., HD. SLOT, 1/4-20 x 1/2" LG
9	P44567	1	SS JAM HEX NUT 1/4-20
10	P31220	12 IN.	#16 GA. WIRE, GREEN
11	P36492	1	TERMINAL LUG
12	P37966	1	TERMINAL LUG
13	P60173	1	WARNING LABEL

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

JUNCTION BOX - PARTS LIST

25.055.000.017B
ISSUE 0 6-97



NOTE: FOR PARTS LIST, SEE DWG. 25.055.004.010B.

MODULE ENCLOSURE - PARTS

25.055.004.010A

ISSUE 5 3-05

KEY NO.	DESCRIPTION	PART NO.	QTY.
[4]	CLIP – PUSH	P57595	20
[6]	PANEL, MODULE END	AAA7142	2
(1)	3/8–16 X 2" LG. HEX BOLT HD.	P56293	4
(2)	1/4–20 X 5/8" LG. SCREW	P19892	10
(3)	3/8 FLAT WASHER	P1090	4
(4)	3/4 FLAT WASHER	PB2018	4
(5)	1/4–20 HEX NUT	P16542	6
(6)	1/4–20 X1"LG MONEL SCREW	P16545	6
(7)	1/4" FLAT WASHER	P16556	22
(8)	MONEL LOCKWASHER	P18102	16
(9)	6–32 X 1/2" LG. SELF TAP SCREW	P58573	8
(10)	MODULE FRAME	AAA6611	2
(11)	TIE STIFFENER NUT	P57579	2
(12)	TIE STIFFENER PLATE	P57580	1
(13)	IDENTIFICATION PLATE	P58164	1
(15)	LOWER FRONT PANEL	AAA5735	1
(16)	UPPER FRONT PANEL	AAA7403	1

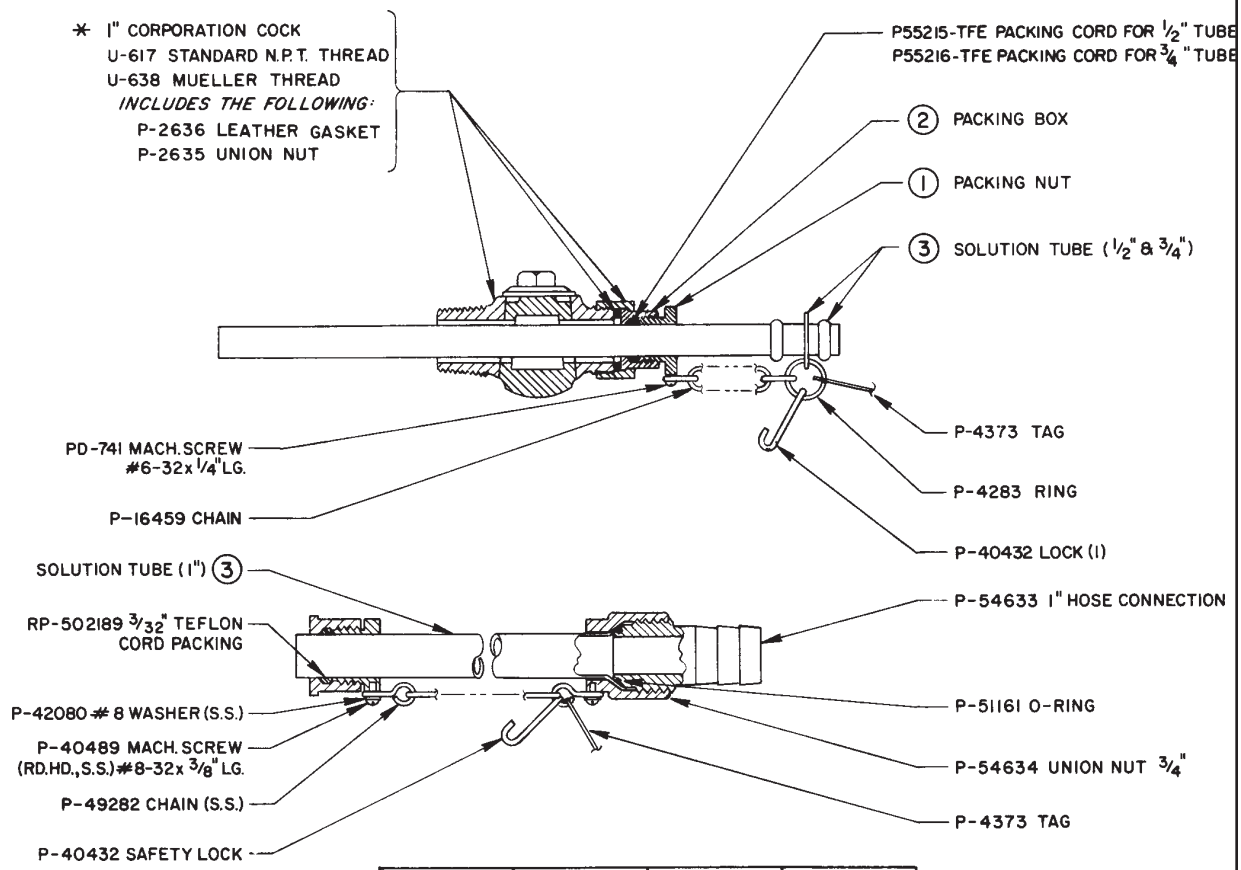
☐ OPTIONAL EQUIPMENT

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

MODULE ENCLOSURE - PARTS LIST

25.055.004.010B

ISSUE 7 3-05



SOLUTION TUBE SIZE	1	2	3
1/2"	P-1129	P-1128	U-2476
3/4"	P-1274	P-1275	U-2475
1"	P-1274	P-1275	P-54632

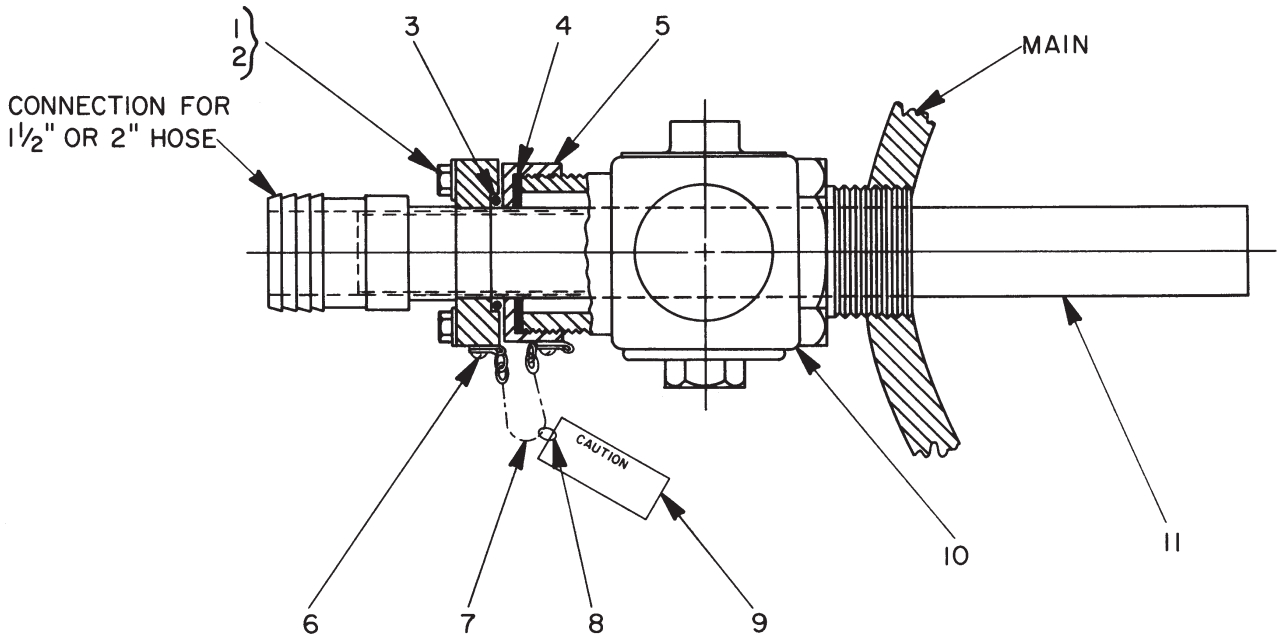
COMPLETE SOLUTION TUBES
* U-1267 – 1/2"
* U-1269 – 3/4"
* U-26488 – 1"

NOTE: * DOES NOT INCLUDE CORPORATION COCK. ORDER SEPARATELY, SPECIFYING PIPE THREAD.

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

MAIN CONNECTION - PARTS
For Hose

50.845.02.011
ISSUE 6 2-82



KEY NO.	PART NO.	QTY.	DESCRIPTION
1	P 5497	4	BOLT (H.H.,SILICON BRONZE) 5/16"-18 x 1-1/4" LG.
2	P 2475	4	5/16" BRASS WASHER
3	P 40374	1	O-RING (326) BUNA-N, 1-5/8" ID x 2" OD
4	P 38090	1	RUBBER GASKET
5	P 54418	1	NUT
6	P 746	2	MACH. SCREW (R.H.,BRASS) #10-32 x 3/8" LG.
7	P 49282	1	SINGLE JACK CHAIN
8	P 4283	1	RING FOR TAG
9	P 4373	1	CAUTION TAG
✳ 10	U 17877	1	2" CORPORATION COCK (NPT)
11	U 17878	1	SOLUTION TUBE FOR U26316
	OR		
	U 17882	1	SOLUTION TUBE FOR U26320

CAUTION: FOR PROPER DISPERSION OF SOLUTION, THE END OF THE TUBE MUST EXTEND INTO THE MAIN APPROXIMATELY 1/2 TO 1/3 THE DIAMETER OF THE MAIN. CUT OFF THE TUBE IF TOO LONG AND SHORTEN CHAIN ANEQUAL AMOUNT.

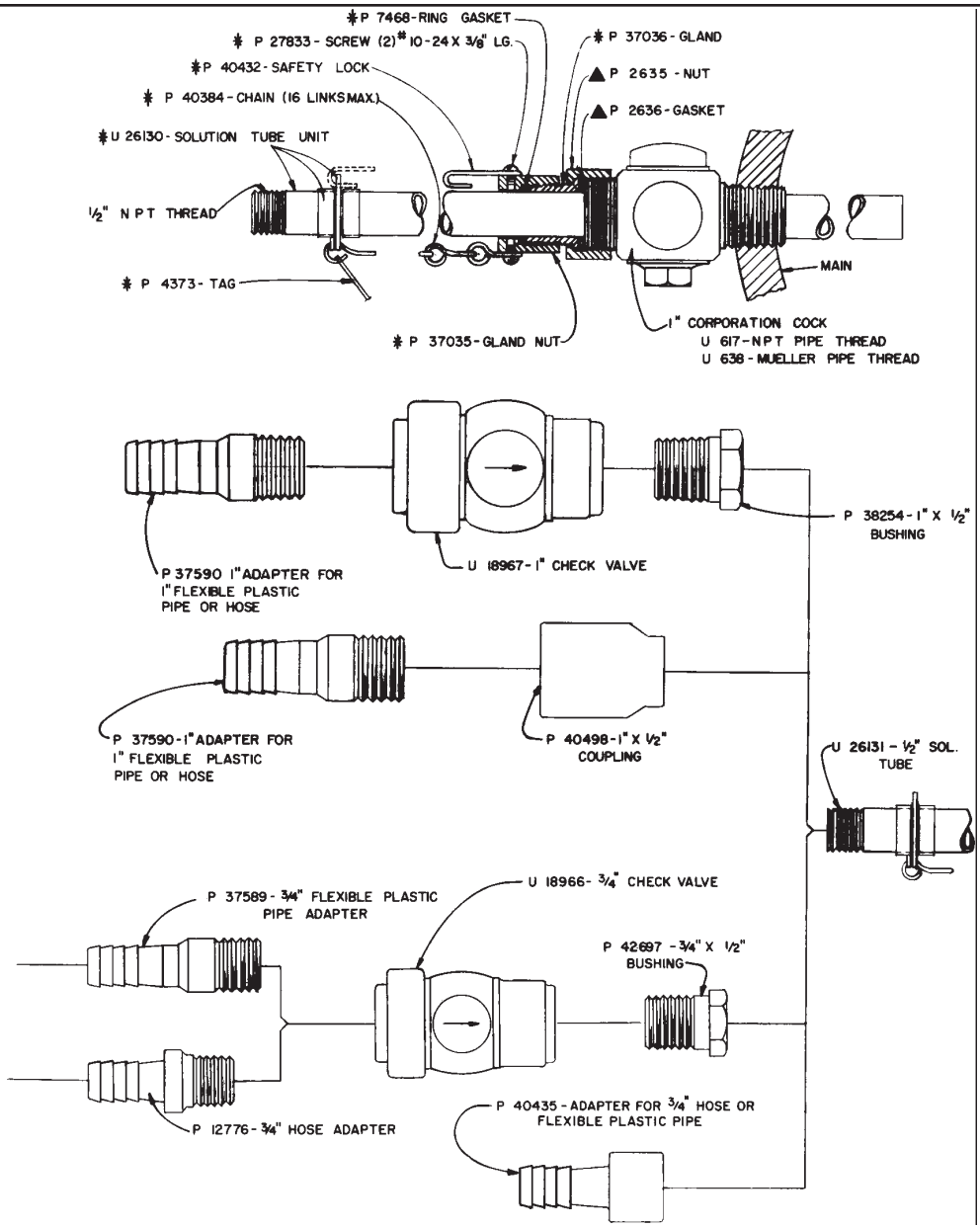
NOTE: MAXIMUM PRESSURE 25 PSI

✳ FOR 2" CORPORATION COCK WITH MUELLER THREAD ORDER UXA 17877.
COMPLETE UNITS - NPT THREAD ONLY U 26316 FOR 1-1/2" HOSE, U 26320 FOR 2" HOSE.

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

2" MAIN CONNECTION - PARTS
With Corporation Cock For 1-1/2" Or 2" Hose

50.845.002.022
ISSUE 4 9-03



NOTE: ✳ PART OF SOLUTION TUBE U26131. ▲ PART OF CORPORATION COCK U617 OR U638.

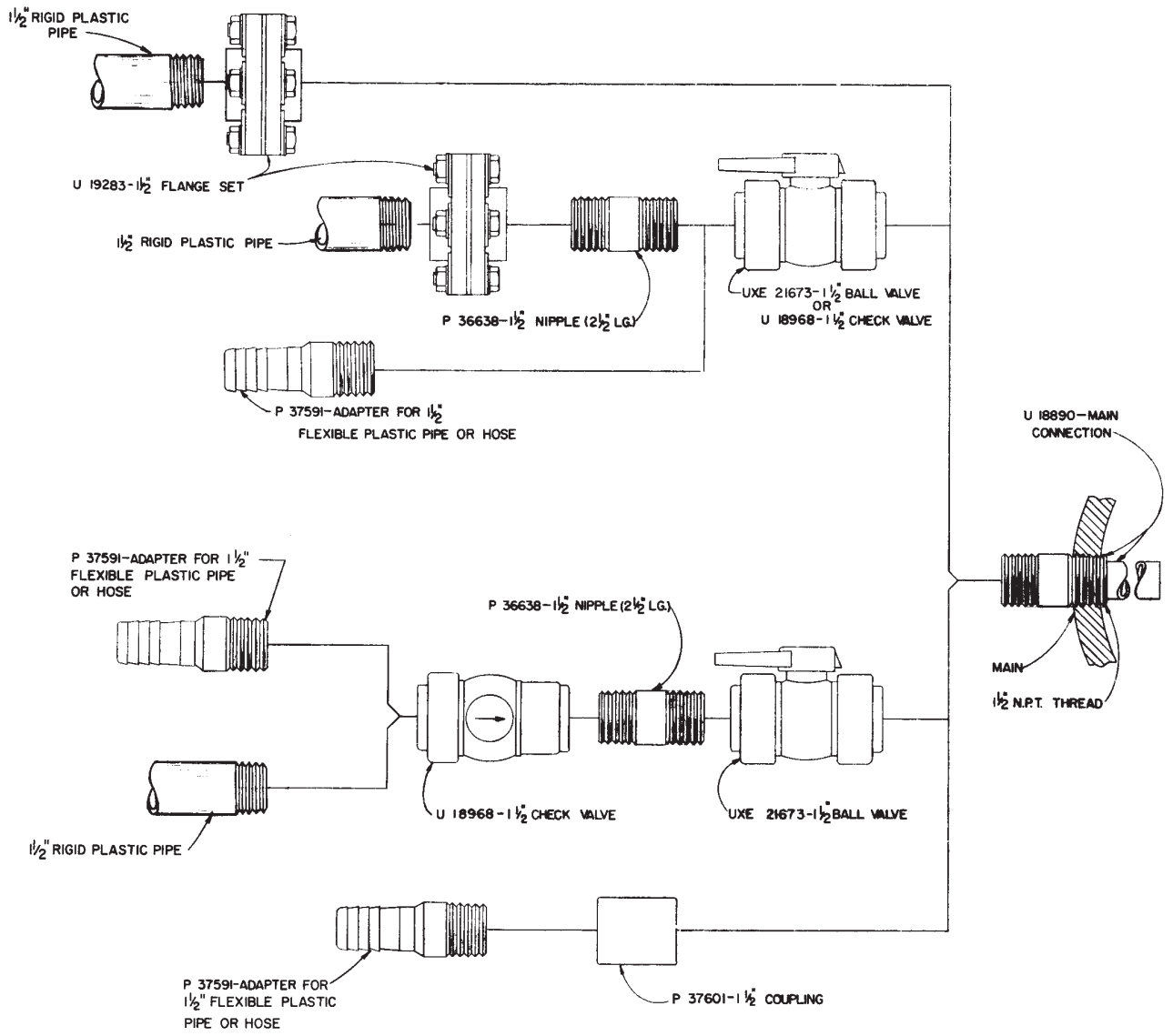
WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO EQUIPMENT, DO NOT EXCEED WORKING PRESSURE OF HOSE OR FLEXIBLE PLASTIC PIPE. NEVER EXCEED 125 PSI AT 70° F. USE RIGID PIPE BETWEEN DISCHARGE AND MAIN CONNECTIONS WHEN PUMPING HAZARDOUS CHEMICALS.

CAUTION: FOR PROPER DISPERSION OF SOLUTION, THE END OF THE TUBE MUST EXTEND INTO THE MAIN, APPROXIMATELY 1/2 TO 1/3 THE DIAMETER OF THE MAIN. CUT OFF THE TUBE IF TOO LONG AND SHORTEN CHAIN AN EQUAL AMOUNT.

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

PLASTIC MAIN CONNECTION - PARTS
For 3/4” Or 1” Solution Lines With 1” Corporation Cock

50.845.06.011
ISSUE 14 2-93



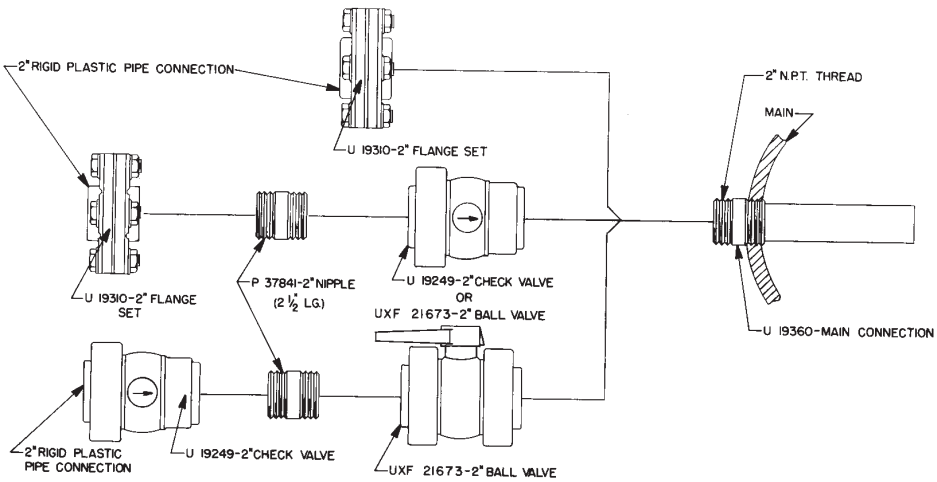
WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO EQUIPMENT, DO NOT EXCEED WORKING PRESSURE OF HOSE OR FLEXIBLE PLASTIC PIPE. NEVER EXCEED 100 PSI AT 70° F. USE RIGID PIPE BETWEEN DISCHARGE AND MAIN CONNECTIONS WHEN PUMPING HAZARDOUS CHEMICALS.

CAUTION: FOR PROPER DISPERSION OF SOLUTION, THE END OF THE TUBE MUST EXTEND INTO THE MAIN, APPROXIMATELY 1/2 TO 1/3 THE DIAMETER OF THE MAIN. CUT OFF THE TUBE IF TOO LONG.

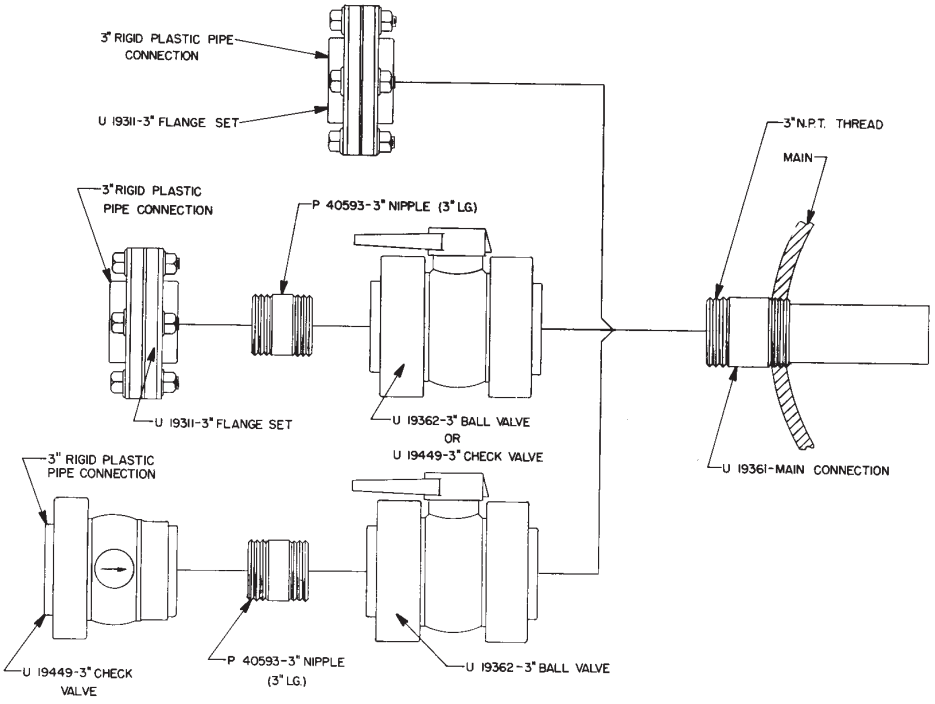
WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

MAIN CONNECTION - PARTS
For 1-1/2” Solution Line

50.845.006.021
ISSUE 12 9-92



2" MAIN CONNECTION



3" MAIN CONNECTION

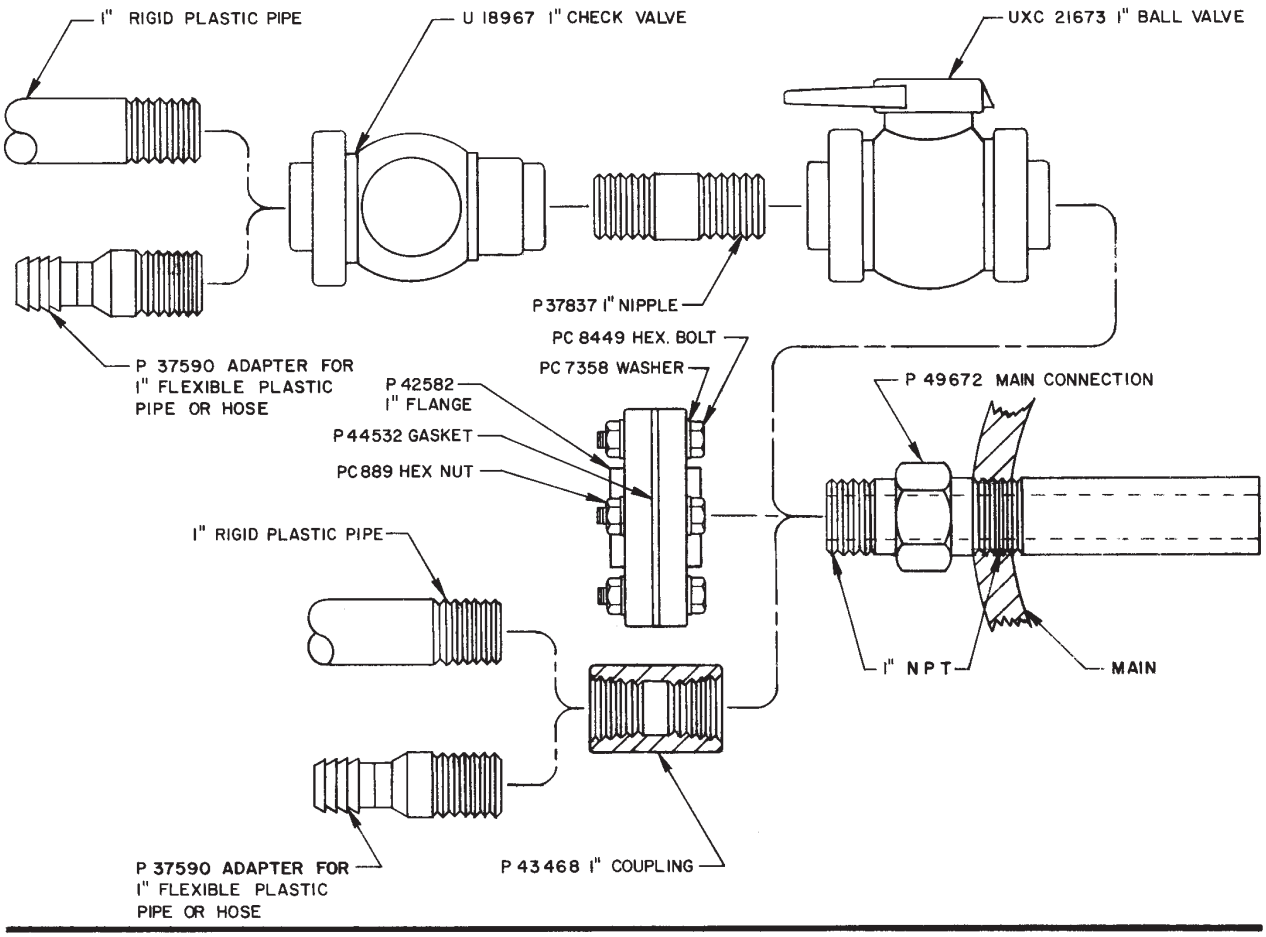
WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO EQUIPMENT, DO NOT EXCEED WORKING PRESSURE OF HOSE OR FLEXIBLE PLASTIC PIPE. NEVER EXCEED 125 PSI AT 70° F. USE RIGID PIPE BETWEEN DISCHARGE AND MAIN CONNECTIONS WHEN PUMPING HAZARDOUS CHEMICALS.

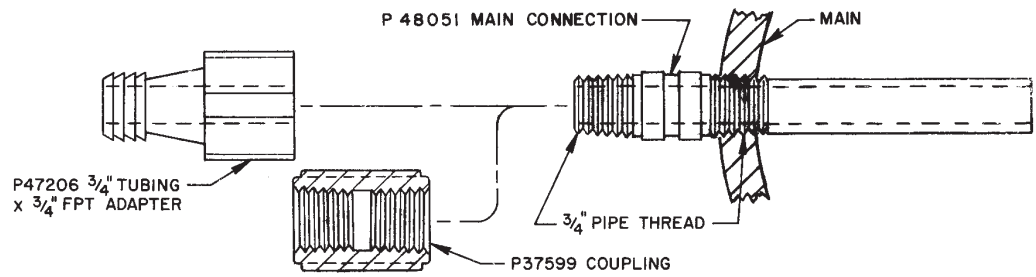
CAUTION: FOR PROPER DISPERSION OF SOLUTION, THE END OF THE TUBE MUST EXTEND INTO THE MAIN, APPROXIMATELY 1/2 TO 1/3 THE DIAMETER OF THE MAIN. CUT OFF THE TUBE IF TOO LONG.

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

MAIN CONNECTION - PARTS
For 2" & 3" Rigid Plastic Pipe

50.845.006.031
ISSUE 7 4-89





WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO EQUIPMENT, DO NOT EXCEED WORKING PRESSURE OF HOSE OR FLEXIBLE PLASTIC PIPE. NEVER EXCEED 140 PSI AT 70° F. USE RIGID PIPE BETWEEN DISCHARGE AND MAIN CONNECTIONS WHEN PUMPING HAZARDOUS CHEMICALS.

CAUTION: FOR PROPER DISPERSION OF SOLUTION, THE END OF THE TUBE MUST EXTEND INTO THE MAIN, APPROXIMATELY 1/2 TO 1/3 THE DIAMETER OF THE MAIN. CUT OFF THE TUBE IF TOO LONG.

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

MAIN CONNECTION - PARTS

For 3/4” or 1” Solution Lines and 3/4” or 1” Main Connections

50.845.06.032

ISSUE 6 7-89

SECTION 6

SECTION 6 - PREVENTIVE MAINTENANCE KITS AND SPARE PARTS LIST

SERIES V-2000 CHLORINATOR 10,000 LB CAPACITY

DESCRIPTION	PART NO.
Preventive Maintenance Kit	U29171

ADDITIONAL SPARE PARTS

QTY	DESCRIPTION	PART NO.
1	Diaphragm (Differential Valve)	U17586
3	Gasket (Differential Valve or Trimmer Valve)	P54865
1	Gasket (Rotameter)	P37541
2	Gasket (Rotameter)	P44120
1	Gasket (V-Notch Plug)	P34530
1	Gasket (V-Notch Plug)	P26482
1	Halocarbon Grease	U27546
1	4 oz. Bottle Ammonia Solution	U409
1	Diaphragm (Trimmer Valve)	U28495
1	O-Ring (Drain Valve)	P50286
1	Umbrella Valve	P60338
1	O-Ring (Check Valve)	PXA39892

SECTION 7

CHLORINE HANDLING MANUAL

(Cl_2)

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

W3T98244

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 Itee
505 Levy Street
St. Laurent, Quebec
H4R 2N9
(450) 582-4266

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.

Table Of Contents

Table Of Contents (Cont'd)

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.

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.

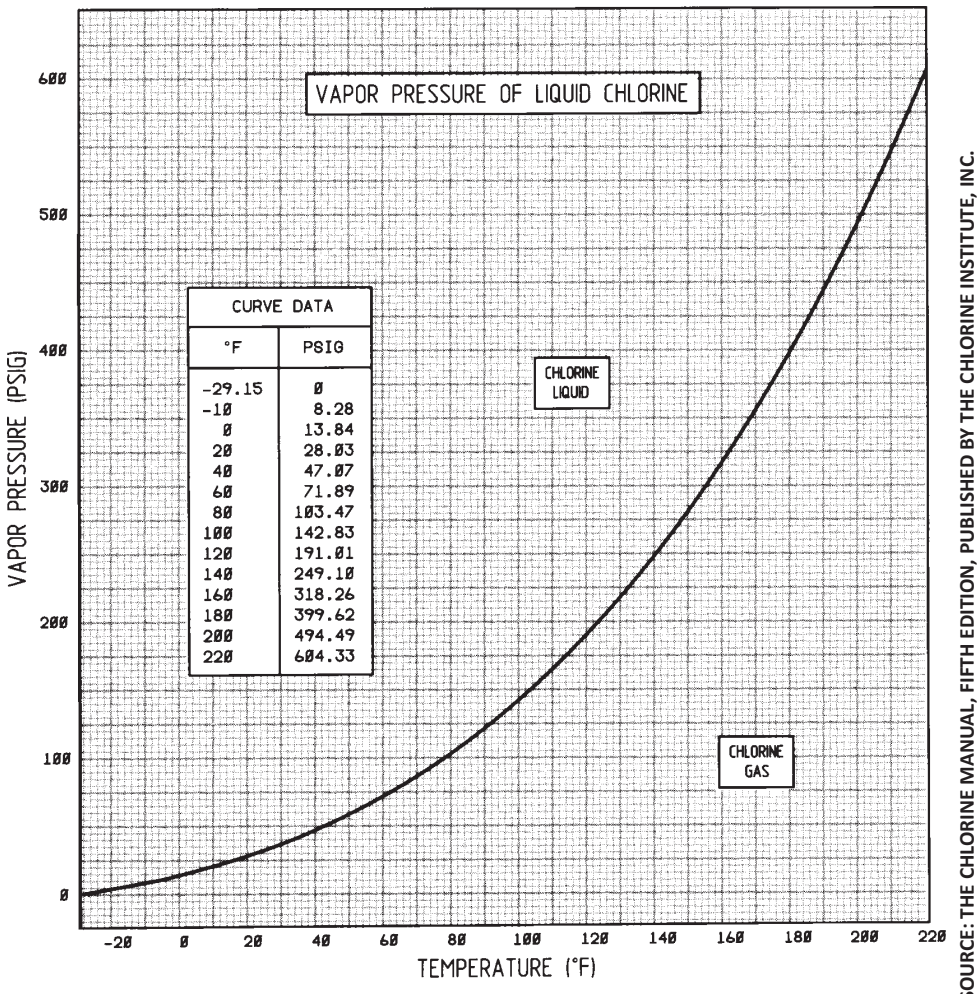
Liquid to Gas volume Ratio
1:456.5 at 32° F and 1 atm.

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.



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

Figure 1 – Chlorine Pressure vs Temperature

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 150 lb	63 - 115 lb 85 - 140 lb	163 - 215 lb 235 - 290 lb	8-1/4" - 10-3/4" 10-1/4" - 10-3/4"	3'3-1/2" - 4'11" 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 30 tons 55 tons 85 tons 90 tons	- - - - -	- - - - -	10'5" - 12'0" 12'4-1/2" - 13'7" 14'3" - 15'1" 14'11" - 15'1" 14'11" - 15'1"	32'2" - 33'3" 33'10" - 35'11-1/2" 29'9" - 43'0" 43'7" - 50'0" 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.

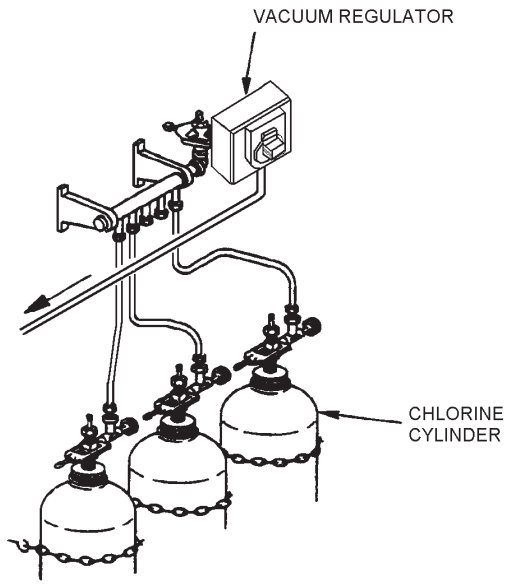


Figure 2 – Manifolding Cylinders

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

<u>WARNING</u>: IN ACCORDANCE WITH CHLORINE INSTITUTE RECOMMENDATIONS, DO NOT MANIFOLD TON CONTAINERS FOR SIMULTANEOUS LIQUID CHLORINE WITHDRAWAL. THIS MANIFOLDING CAN CAUSE OVERPRESSURIZATION 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.

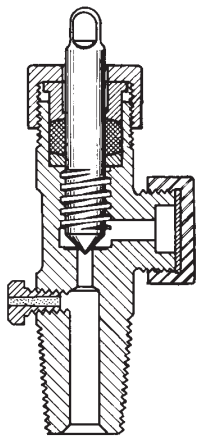


Figure 3 – Standard Cylinder Valve

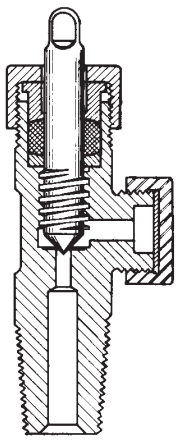
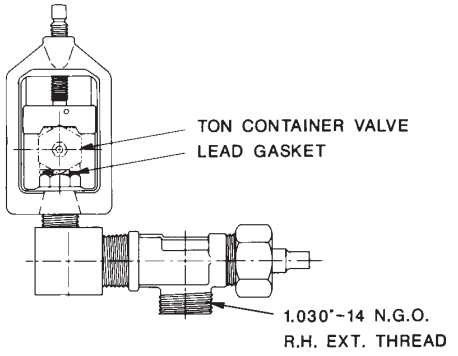
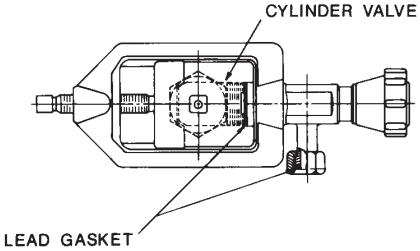


Figure 4 – Standard Ton Container Valve



CAPTIVE YOKE AUXILIARY TON CONTAINER VALVE



CAPTIVE YOKE AUXILIARY CYLINDER 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.

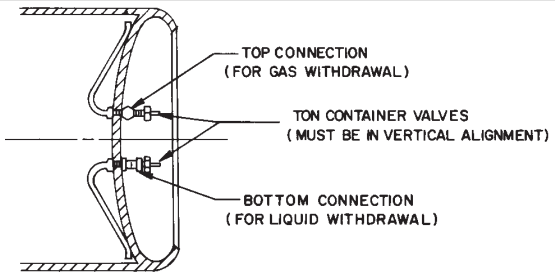


Figure 6 – Ton Container Valves

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.

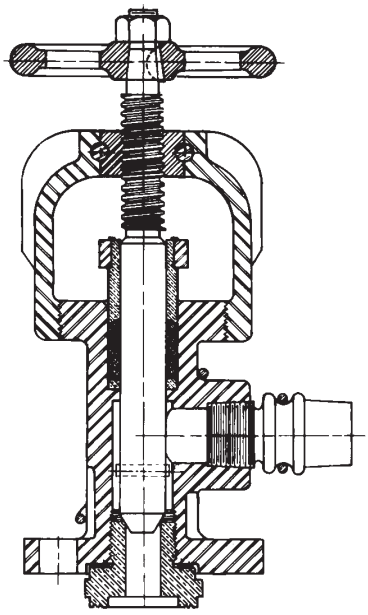


Figure 7 – Standard Angle Valve

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.

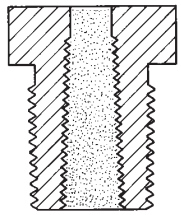


Figure 8 – Standard Fusible Plug for Ton Containers

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.

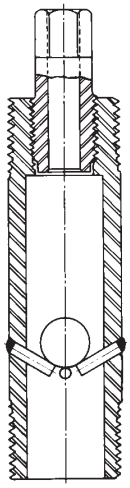


Figure 9 – Excess-Flow Valve

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

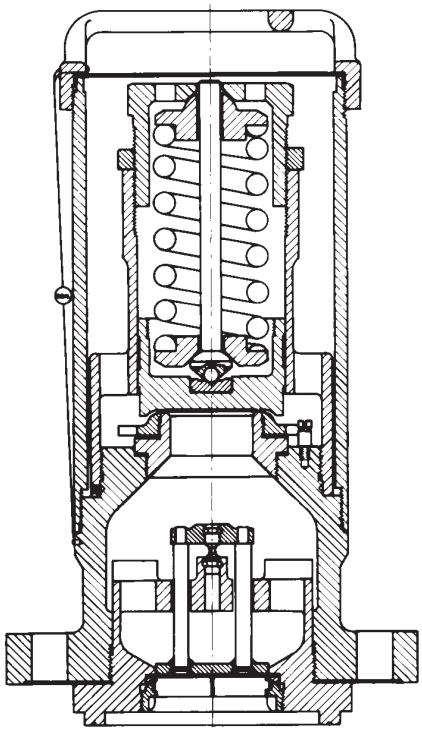


Figure 10 – Standard Safety Relief Device

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).

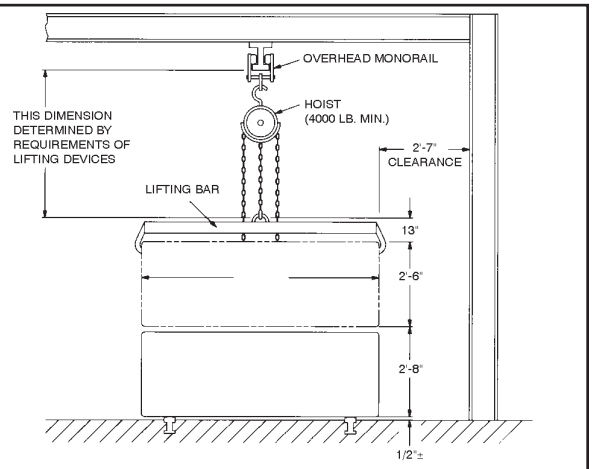


Figure 11 – Ton Container Handling

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 DETERIORATION).

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 eduction 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

It is important to avoid conditions that will encourage

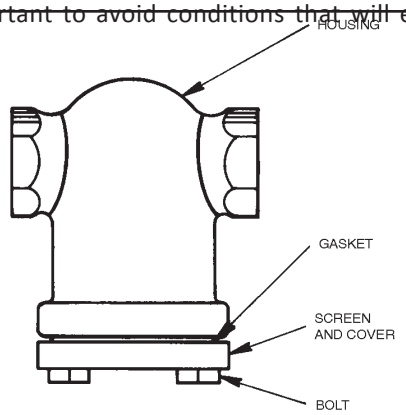


Figure 12 – Chlorine Gas Strainer

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.

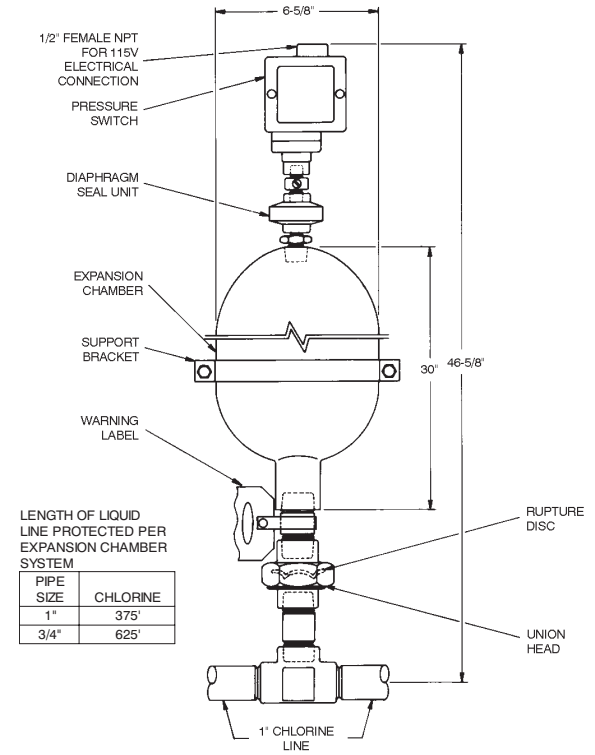


Figure 13 – Liquid Line Pressure Relief System

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.

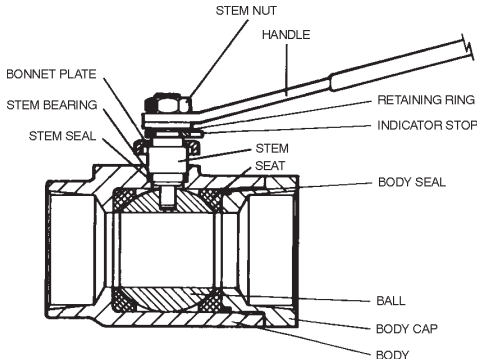


Figure 15 – Gas and Liquid Ball Valve

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 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.

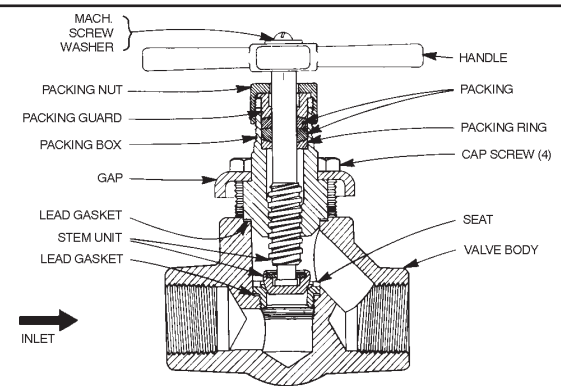


Figure 14 – 3/4- and 1-Inch Line Valves

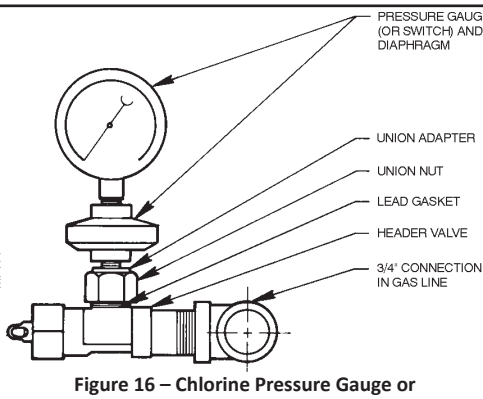


Figure 16 – Chlorine Pressure Gauge or Switch Mounted on Header Valve

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.

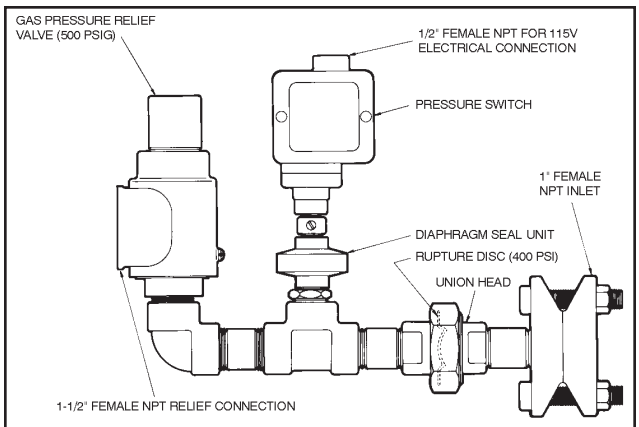


Figure 17 – Evaporator Pressure Relief System

<u>WARNING</u>: 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.

<u>WARNING</u>: 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.

<u>WARNING</u>: MOISTURE MUST BE REMOVED FROM ANY PART OF THE EQUIPMENT THAT IS NORMALLY EXPOSED TO DRY CHLORINE ONLY. WHILE DRY CHLORINE IS NONCORROSIVE, 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.

<u>WARNING</u>: 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.