

Wallace & Tiernan[®]

an eVOQUA brand

Series 50-200 Evaporator For Chlorine

BOOK NO. WT.050.200.001.UA.IM.0814

W3T198237

**SERIES 50-200
EVAPORATOR
FOR CHLORINE**

BOOK NO. WT.050.200.001.UA.IM.0814

50-200 EVAPORATOR FOR CHLORINE

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

The Evoqua Water Technologies Series 50-200 Evaporator for Chlorine described in this instruction book changes the state of chlorine from liquid to gas to supply other gaseous flow control apparatus.

The Series 50-200 Evaporator comprises a steel cylinder immersed in a hot water bath, an external heat exchanger, and associated control devices.



WARNING: HAZARDOUS GAS IS PRESENT IN THIS EQUIPMENT DURING NORMAL OPERATION. TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT THROUGH MISUSE, THIS EQUIPMENT SHOULD BE INSTALLED, OPERATED, AND SERVICED ONLY BY TRAINED, QUALIFIED PERSONNEL WHO ARE THOROUGHLY FAMILIAR WITH THE ENTIRE CONTENTS OF THIS INSTRUCTION BOOK AND THE CHLORINE HANDLING MANUAL.

This instruction book covers three versions of the evaporator: (1) standard version W3T97879, (2) lethal certified version W3T97880, and (3) the MLS version W3T99684 for our customers located in the People's Republic of China.

Both versions have identical subassembly and component parts except for the pressure cylinder. The cylinder in the “standard” version is fabricated to meet all requirements of Section VIII of the ASME Code for Unfired Pressure Vessels. The “standard” evaporator is therefore suitable for chlorine, sulfur dioxide, or ammonia service (as labeled) in all applications. If, however, the customer requires either a “lethal certified” cylinder or a greater wall thickness for extra corrosion allowance, the “lethal rated” version is provided.

CANADIAN USERS NOTE: Canadian law requires that the owner of an evaporator have it registered with the local authorities prior to operating it, as it is a pressure vessel. The evaporator cylinder is manufactured to ASME codes and is stamped with Canadian Registration Number CRN HO 618-5 or D1429-5.

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

50-200 EVAPORATOR FOR CHLORINE

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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 MUST BE COMPLETELY FAMILIAR WITH YOUR LOCAL PLANT OPERATING AND EMERGENCY PROCEDURES AND CHLORINE INSTITUTE RECOMMENDED EMERGENCY PROCEDURES.

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

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

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

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

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

VERY IMPORTANT SAFETY PRECAUTIONS - CHLORINE (CONT'D)

THE TWO MOST COMMON CAUSES OF CHLORINE PIPING LEAKS ARE:

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

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

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

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

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

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

NOTE

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

VERY IMPORTANT SAFETY PRECAUTIONS

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

THIS EQUIPMENT IS SUITABLE FOR USE WITH CHLORINE ONLY. DO NOT USE WITH OTHER GASES. SUCH USE CAN RESULT IN MALFUNCTION OR FAILURE OF VARIOUS COMPONENTS, CAUSING POSSIBLE SEVERE PERSONAL INJURY.

TO AVOID SEVERE PERSONAL INJURY AS A RESULT OF A CHLORINE LEAK(S), ENSURE THAT THE CHLORINATOR IS READY FOR OPERATION BEFORE CHLORINE IS INTRODUCED INTO THE EVAPORATOR AND ITS CONNECTING PIPELINES. OPERATION OF THE CHLORINATOR MAY BE NECESSARY TO DISPOSE OF CHLORINE TO PERMIT THE REPAIR OF LEAKS. IF THE EVAPORATOR IS USED WITHOUT A CHLORINATOR, PROVIDE AN ALTERNATE MEANS OF DISPOSAL.

IF THE SUPPLY CONTAINER DOES NOT HAVE ADEQUATE RESERVE CAPACITY TO ACCEPT THE MAXIMUM CONTENTS THAT ARE BEING FORCED FROM THE EVAPORATOR CYLINDER, DO NOT STOP CHLORINATION. INSTEAD, IN ORDER TO PREVENT OVER-FILLING AND DEVELOPING EXTREME PRESSURES WITHIN THE SUPPLY CONTAINER, CLOSE THE SUPPLY VALVE AND USE THE CHLORINATOR OR GAS DISPOSAL SYSTEM TO COMPLETELY EVACUATE THE EVAPORATOR AND ITS CONNECTING PIPELINES.

TO AVOID SEVERE PERSONAL INJURY OR CYLINDER RUPTURE, DO NOT INSTALL A VALVE OF ANY TYPE BETWEEN THE EVAPORATOR DISCHARGE AND THE GAS PRESSURE RELIEF SYSTEM. RUN THE OUTFLOW FROM THE RELIEF VALVE TO ATMOSPHERE. TERMINATE THE RELIEF LINE 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 FOR ALTERNATE METHODS OF DISPOSAL.

TO AVOID AN OVERPRESSURE CONDITION CAPABLE OF RUPTURING THE PIPING SYSTEM AND RESULTING IN A DISCHARGE OF GAS FROM THE GAS PRESSURE RELIEF SYSTEM, DO NOT CLOSE ANY VALVE OR VALVES BETWEEN THE EVAPORATOR AND THE CHLORINE SUPPLY WITHOUT FOLLOWING THE EVACUATION PROCEDURE DESCRIBED IN THIS INSTRUCTION BOOK. LIQUID CHLORINE HAS A HIGH COEFFICIENT OF THERMAL EXPANSION. DO NOT CLOSE VALVES IN SUCH A WAY THAT LIQUID CHLORINE MAY BE TRAPPED, SINCE DANGEROUS PRESSURES CAPABLE OF RUPTURING THE PIPING SYSTEM MAY BUILD UP WITH A SMALL INCREASE IN TEMPERATURE.

DO NOT REMOVE THE PRESSURE RELIEF SYSTEM WHILE THE EVAPORATOR IS PRESSURIZED.

TO AVOID A MAJOR RELEASE OF CHLORINE, DO NOT OPEN THE LIQUID LINE PRESSURE RELIEF SYSTEM WHILE THE EVAPORATOR IS PRESSURIZED.

THE GAS LINE TO THE REGULATING VALVE MUST BE SHORT WITH A SLIGHT DOWN-GRADE TOWARD THE EVAPORATOR, ALLOWING ANY RELIQUEFIED CHLORINE TO DRAIN BACK TO THE EVAPORATOR. THIS WILL PREVENT ANY RELIQUEFIED CHLORINE FROM REACHING AND DAMAGING EQUIPMENT DOWNSTREAM OF THE REGULATING VALVE.

VERY IMPORTANT SAFETY PRECAUTIONS (CONT'D)

TO AVOID RUPTURE OF THE SUPPLY CONTAINER, CAUSING POSSIBLE SEVERE PERSONAL INJURY, CLOSE THE SUPPLY VALVE AND USE THE CHLORINATOR OR GAS DISPOSAL SYSTEM TO COMPLETELY EVACUATE THE EVAPORATOR CYLINDER AND ITS CONNECTING PIPELINES.

ALL TWO-BOLT AMMONIA AND RUPTURE DISC UNIONS ARE ONLY LIGHTLY TIGHTENED FOR SHIPPING. TO AVOID SEVERE PERSONAL INJURY FROM A CHLORINE LEAK, FIRMLY TIGHTEN ALL UNIONS AFTER PIPING IS INSTALLED.

TO AVOID THE RUPTURE OF THE EVAPORATOR PRESSURE CYLINDER OR ITS CONNECTING PIPELINES, CAUSING POSSIBLE SEVERE PERSONAL INJURY AND EQUIPMENT DAMAGE, DO NOT ATTEMPT TO DISASSEMBLE OR REPAIR THE RELIEF VALVE. IF IT MALFUNCTIONS, REPLACE IT.

SECURELY SUPPORT THE EXPANSION TANK (e.g., WITH A BRACKET) TO AVOID DAMAGE THAT COULD RESULT IN A MAJOR RELEASE OF LIQUID.

USE ONLY WATER TO FILL THE HOT WATER TANK AND HEAT EXCHANGER. DO NOT USE ANY SUBSTITUTE FLUID. THE BOILING TEMPERATURE OF WATER PROVIDES A LIMIT ON AN ACCIDENTAL OVER-TEMPERATURE CONDITION, THEREBY LIMITING THE GAS PRESSURE INSIDE THE EVAPORATOR CYLINDER.

THE TOP OF THE TANK WILL BE HOT (180°F). TO AVOID SEVERE PERSONAL INJURY DUE TO HOT SURFACES, DO NOT REMOVE OR REINSTALL CAPPLUG WITH BARE HANDS; USE A GLOVE OR OTHER INSULATING MATERIAL.

WHEN DRAINING HOT WATER OUT OF HEAT EXCHANGER, ALLOW WATER TO COOL BEFORE REMOVING PLUG.

TO AVOID SEVERE PERSONAL INJURY FROM BURNS DUE TO HOT WATER IN SIGHTGLASS TUBE, TURN POWER OFF AND DRAIN THE TANK ENOUGH SO THAT NO WATER IS VISIBLE IN THE SIGHTGLASS. ALLOW THE SIGHTGLASS TO COOL BEFORE HANDLING.

WHEN HANDLING HAZARDOUS MATERIAL, IT IS THE RESPONSIBILITY OF THE EQUIPMENT USER TO OBTAIN AND OBSERVE ALL SAFETY PRECAUTIONS RECOMMENDED BY THE MATERIAL MANUFACTURER/SUPPLIER.

BOLT THE EVAPORATOR SECURELY TO THE CONCRETE PAD.

LIFT THE EVAPORATOR BY A CRANE HAVING NO LESS THAN A ONE-TON CAPACITY RATING.

TO AVOID SEVERE PERSONAL INJURY FROM ACCIDENTAL EXPOSURE TO HIGH VOLTAGE, THE EVAPORATOR MUST BE SUITABLY GROUNDED TO EARTH BEFORE START-UP. USE THE GROUNDING CONNECTOR PROVIDED.

LINE VOLTAGE IS PRESENT INSIDE THE CONTROL BOX EVEN WHEN THE PANEL POWER SWITCH IS IN THE OFF POSITION. TO AVOID POSSIBLE SEVERE PERSONAL INJURY DUE TO ELECTRICAL SHOCK, DISCONNECT THE EXTERNAL POWER SUPPLY BEFORE SERVICING.

VERY IMPORTANT SAFETY PRECAUTIONS (CONT'D)

TO AVOID POSSIBLE SEVERE PERSONAL INJURY FROM ELECTRICAL SHOCK, BE CAREFUL NOT TO TOUCH THE METAL SCREWS ON THE TERMINALS OF THE PRESSURE SWITCH. THESE TERMINALS ARE CONNECTED TO 115 VOLTS.

TO AVOID POSSIBLE SEVERE PERSONAL INJURY DUE TO EQUIPMENT MALFUNCTION, SEMI-ANNUALLY MAKE A COMPLETE ELECTRICAL CHECK OF THE OPERATION OF THE TEMPERATURE, WATER LEVEL AND PRESSURE RELIEF ALARM SWITCHES. IF THE APPROPRIATE RESPONSE IS NOT OBSERVED, REPLACE THE FAULTY CONTROL UNIT.

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 HANDLING MANUAL FOR RECOMMENDED PROCEDURE.

USE ONLY EVOQUA WATER TECHNOLOGIES LISTED PARTS, EXCEPT FOR THOSE COMMERCIALY AVAILABLE PARTS IDENTIFIED BY COMPLETE DESCRIPTION ON THE 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 TO PROPER AND SAFE OPERATION AND MAINTENANCE.

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

NOTE

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

50-200 EVAPORATOR FOR CHLORINE

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

50-200 EVAPORATOR FOR CHLORINE

SECTION 1 - TECHNICAL DATA

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1.1 General



WARNING: THIS EQUIPMENT IS SUITABLE FOR USE WITH CHLORINE ONLY. DO NOT USE WITH OTHER GASES. SUCH USE CAN RESULT IN MALFUNCTION OR FAILURE OF VARIOUS COMPONENTS CAUSING POSSIBLE SEVERE PERSONAL INJURY.

1.2 Application

The Series 50-200 Evaporator is available for either Indoor or Outdoor Service (optional), and in the following chlorine evaporating capacities:

- 6,000 lb/24 hr. maximum capacity with 12 kW heaters.
- 8,000 lb/24 hr. maximum capacity with 15 kW heaters.
- 10,000 lb/24 hr. maximum capacity with 18 kW heaters.

Part numbers for these arrangements are provided in Section 5. See Dwg. 50.200.060.010.

50-200 EVAPORATOR FOR CHLORINE

1.3 Technical Data

Chlorine Capacity	6,000, 8,000 or 10,000 lb/24 hr. depending on heater size.
Heat Source	Electrically powered hot water heat exchanger.
Electrical Requirements	3-phase power at nominal voltage level determined by customer during order. Available nominal voltage requirements are: 208V, 220V, 240V, 380V, 440V, 480V, and 550V.
Water Requirements	10 psi minimum city quality water
Liquid Chlorine Supply Pressure	30-140 psi

NOTE: Customer voltage supply corresponding to the nominal must be within the range of the minimum and maximum values of voltage specified in Section 2, Table 2.1. Single phase 115V power is not required. The controls and equipment obtain single phase power through the use of a 1kVA transformer located in the control box.

Evaporator Cylinder Rated Working Pressure	560 psi
Relief Valve Setting	560 psi
Installed Weight (Hot water tank and cylinder filled)	1100 lb. (approximately)

50-200 EVAPORATOR FOR CHLORINE

SECTION 2

50-200 EVAPORATOR FOR CHLORINE

SECTION 2 - INSTALLATION

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WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO EQUIPMENT, READ AND UNDERSTAND THIS ENTIRE PREPARATION PROCEDURE AND FAMILIARIZE YOURSELF WITH THE CHLORINE HANDLING MANUAL BEFORE PERFORMING ANY WORK. BE SURE THE CHLORINE SUPPLY REMAINS OFF UNTIL INSTRUCTED TO TURN IT ON.

2.1 General

NOTE: Reference to optional equipment may be disregarded if such equipment is not a part of your installation.



WARNING: WHEN HANDLING HAZARDOUS MATERIAL, IT IS THE RESPONSIBILITY OF THE EQUIPMENT USER TO OBTAIN AND OBSERVE ALL SAFETY PRECAUTIONS RECOMMENDED BY THE MATERIAL MANUFACTURER/SUPPLIER.

The Series 50-200 Evaporator is shipped completely assembled and ready for installation. For the location of the various evaporator components, see Dwg. 50.200.110.010.

2.2 Unpacking and Base Mounting

- a. Unfasten and remove shipping crate.
- b. If a back cover (outdoor option) was provided, remove it. Loosen and remove the bolts located at the top of the evaporator where the enclosure sides are fastened together.
- c. Loosen the black, quarter-turn screws in the side panels of the enclosure.

NOTE: Do not attempt to remove the quarter-turns screws as they are retained on the reverse side of the panel by grommets.

- d. Remove the side panels. Do not replace them until the evaporator is ready for operation.
- e. Remove top cover and pipe trim.
- f. Attach two lifting hooks, each with no less than 1/2-ton capacity rating, to the lifting brackets that extend out a few inches from the gray insulation ring.
- g. Chain the lifting hooks together to a hoist or crane.



WARNING: TO AVOID SEVERE PERSONAL INJURY, LIFT THE EVAPORATOR BY A CRANE HAVING NO LESS THAN A ONE-TON CAPACITY RATING. LIFT EVAPORATOR ONLY IN THE MANNER SHOWN ON DWG. 50.200.110.030.

- h. Unbolt the evaporator from the wooden base. Lift and lower the evaporator onto a concrete mounting pad prepared according to the mounting details in Dwg. 50.200.100.010. Bolt the evaporator to the pad.
- f. Replace top cover and pipe trim.



WARNING: TO AVOID SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, BOLT THE EVAPORATOR SECURELY TO THE CONCRETE PAD.

2.3 Piping

2.3.1 Chlorine Gas and Liquid Piping



WARNING: ALL TWO-BOLT AMMONIA AND RUPTURE DISC UNIONS ARE ONLY LIGHTLY TIGHTENED FOR SHIPPING. TO AVOID SEVERE PERSONAL INJURY FROM A CHLORINE LEAK, FIRMLY TIGHTEN ALL UNIONS AFTER PIPING IS INSTALLED.

NOTE: Piping for chlorine should conform to Chlorine Institute recommendations.

An ammonia-type union is furnished to accommodate the one-inch chlorine gas outlet (discharge) pipe. The chlorine gas outlet pipe and union extends upward from the gray insulation ring at the top of the evaporator. The gas pressure relief system and a vacuum regulator-check unit (or gas pressure reducing valve) must be installed in this line. Refer to Dwg. 50.200.110.010 for proper installation. The vacuum regulator-check unit is electrically operated. The gas pressure reducing valve can be pilot-operated by air or water or can be electrically operated. Separate instructions are furnished with either valve.



WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, THE GAS LINE TO THE REGULATING VALVE MUST BE SHORT, WITH A SLIGHT DOWN-GRADE TOWARDS THE EVAPORATOR, ALLOWING ANY RELIQUIFIED CHLORINE TO DRAIN BACK TO THE EVAPORATOR. THIS WILL PREVENT ANY RELIQUIFIED CHLORINE FROM REACHING AND DAMAGING EQUIPMENT DOWNSTREAM OF THE REGULATING VALVE.

There are two points at which chlorine liquid can be brought into the evaporator. The top connection may be used as a convenience from a piping standpoint when there is only a single evaporator being used. The bottom connection is required when manifolding several evaporators for high capacity. For single evaporators, the bottom connection provides an alternate inlet connection. The bottom connection is also used as a drain when cleaning the evaporator in place. Ammonia unions are furnished at both liquid inlet points.

2.3.2 Water Piping (See Dwg. 50.200.110.010)

In the unlikely occurrence of a leak in the evaporator pressure cylinder, chlorine may be present in the water drain-overflow and vapor vent outlet lines.



WARNING: TERMINATE THE VAPOR VENT AND DRAIN/OVERFLOW LINES IN AREAS WHERE NO INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT WILL OCCUR.

- a. Make a 1-1/4-inch connection to the combination water bath drain-overflow line, and connect it to the appropriate plant piping.
- b. Make a 1-1/4-inch connection to the vapor vent outlet and connect it to the appropriate plant piping.
- c. Connect a 1/2-inch supply (10 psi min., 135 psi max.) to the water supply for the purpose of water make-up to the hot water tank.

2.4 Evaporator Gas Pressure Relief System

The Gas Pressure Relief System (see Dwg. 50.202.008.011, Section 5) is provided as a preassembled unit.



WARNING: TO AVOID SEVERE PERSONAL INJURY OR CYLINDER RUPTURE, DO NOT INSTALL A VALVE OF ANY TYPE BETWEEN THE EVAPORATOR DISCHARGE AND THE GAS PRESSURE RELIEF SYSTEM. RUN THE OUTFLOW FROM THE RELIEF VALVE TO ATMOSPHERE. TERMINATE THE RELIEF LINE 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 FOR ALTERNATE METHODS OF DISPOSAL.



CAUTION: To ensure proper operation, install the system with the relief valve in a vertical position.

Install the Gas Pressure Relief System in the gas discharge line as shown in Dwg. 50.200.110.010. The purpose of this system is to prevent rupture of the pressure cylinder or related piping in case of an extreme over-pressure condition. A detailed view of this system is provided in Dwg. 50.202.008.011.

2.4.1 Gas Pressure Relief Valve Discharge

NOTE: The relief valve outlet may be either 1-1/2-inch or 1-inch NPT depending on valve furnished.

To provide for friction losses, use the following pipe sizes:

Discharge line less than 50 feet long: use 1-or 1-1/2-inch, schedule 40 carbon steel pipe.

Discharge line 50 to 100 feet long: use 1-1/2-inch, schedule 40 carbon steel pipe.

The ASME Boiler and Pressure Vessel Code, Section VIII Division 1 UA-356, appendix M, provides guidance for relief system discharge piping. The following is an excerpt from that code:

UA-356 Discharge Lines From Safety Devices.

- (a) Where it is feasible, the use of a short discharge pipe or vertical riser, connected through long-radius elbows from each individual device, blowing directly to the atmosphere, is recommended. Such discharge pipes shall be at least of the same size as the valve outlet....
- (b) When discharge lines are long ... the effect of the back pressure that may be developed therein ... must be considered
- (c) All discharge lines shall be run as direct as is practicable to the point of final release for disposal. For the longer lines, due consideration shall be given to the advantage of long-radius elbow, avoidance of close-up fittings, and the minimizing of excessive line strains by expansion joints and well-known means of support to minimize line-sway and vibration under operating conditions.

NOTE: It is recognized that no simple rule can be applied generally to fit the many installation requirements which vary from simple short lines that discharge directly to the atmosphere to the extensive manifold discharge piping systems where the quantity and rate of the product to be disposed of requires piping to a distant safe place.

2.5 Liquid Line Pressure Relief System

If liquid is trapped in the supply pipe between two pipes, liquid expansion can result in pipe rupture. To avoid this, a means of pressure relief is furnished. (See the Chlorine Handling Manual.)

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The liquid line pressure relief system is provided as a pre-assembled unit and needs only to be installed in the liquid line. (See Dwgs. 50.200.110.010 and 50.202.007.011.)

The length of liquid line protected per expansion chamber system.

PIPE SIZE	CHLORINE	SULFUR DIOXIDE	AMMONIA
1"	375'	435'	355'
3/4"	625'	720'	560'



CAUTION: To prevent damage to the rupture disc due to inadvertent overpressure, and to permit checking the pressure switch electrical alarm wiring, do not install rupture disc until initial leak testing is completed.



CAUTION: To ensure proper operation of the Liquid Line Pressure Relief System, install the expansion chamber vertically, with the pressure switch on top.



WARNING: SECURELY SUPPORT THE EXPANSION TANK (E.G., WITH A BRACKET) TO AVOID DAMAGE THAT COULD RESULT IN A MAJOR RELEASE OF LIQUID, CAUSING POSSIBLE SEVERE PERSONAL INJURY.

2.6 Wiring

The components inside the control box and the equipment inside the evaporator enclosure have been factory pre-wired. Customer-made connections for power, alarms, and the gas regulating valve are shown on Dwg. 50.200.130.010.



CAUTION: Alarm connections on the printed circuit board must be wired to actuate appropriate alarm devices (either customer-supplied or supplied by Evoqua Water Technologies) as shown in the Installation drawings.

Connect alarm devices for low water temperature, high water temperature, and low water level conditions to the unpowered contacts on the printed circuit board. These contacts are rated for 10 amps at 120 volts ac and 30 volts dc. Connect the vacuum regulator-check unit (or gas pressure reducing valve) to the powered contacts (120VAC) on the printed circuit board. (Refer to Figure 2.1.) Run the wiring for these devices through the rigid conduit supplied at the top left of the enclosure. Clamps are provided inside the box for securing these wires (for alarms and the regulating valve) neatly to the panel.

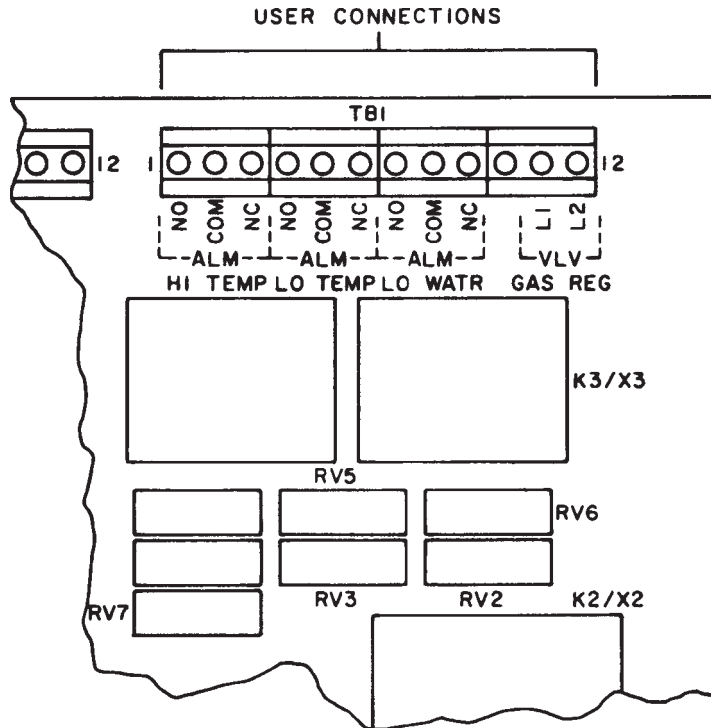


Figure 2.1 - Control Enclosure Circuit Board



CAUTION: Improper wiring may damage equipment.

Connect the appropriate three-phase power supply to the disconnect switch located in the upper right hand corner of the control box. Connect the ground wire of the supply to the grounding connector provided to the left of the disconnect switch. (Refer to Figure 2.2.) Run these wires through the rigid conduit provided at the top right of the enclosure.

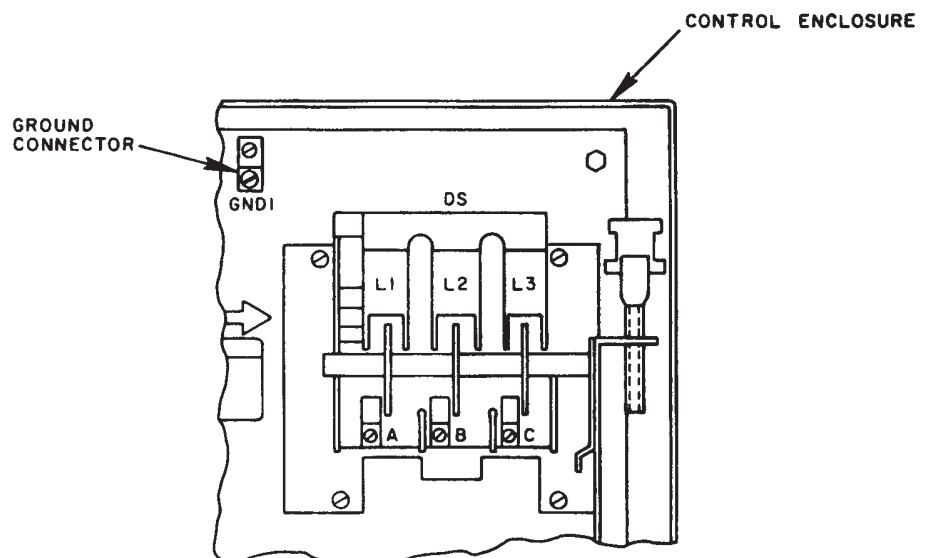


Figure 2.2 - Three-Phase Power Supply and Ground Location

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WARNING: TO AVOID SEVERE PERSONAL INJURY FROM ACCIDENTAL EXPOSURE TO HIGH VOLTAGE, THE EVAPORATOR MUST BE SUITABLY GROUNDED TO EARTH BEFORE START-UP. USE THE GROUNDING CONNECTOR PROVIDED. (SEE DRAWING 50.200.130.010 FOR LOCATION OF GROUNDING LUG INSIDE CONTROL BOX.)



CAUTION: The three-phase user power supply must be within the minimum and maximum voltage range corresponding to the nominal voltage rating label located just above the disconnect switch in the control box. See Table 2.1 for this voltage range. Refer to the actual control box to verify that the nominal voltage rating of the evaporator controls is the same as your power supply.

Table 2.1 - Power Supply Voltage Ranges

Nominal Voltage Rating	User Voltage Supply	
	Minimum	Maximum
208	192	218
220	194	233
240	212	254
380	336	402
440	389	466
480	424	508
550	486	582



CAUTION: If your power supply does not fall within the proper range, do not connect power. Contact your nearest Evoqua Water Technologies regional office for assistance.

NOTE: Field wiring must conform to local electrical code requirements.

2.6.1 Controls (See Dwg. 50.200.170.010)

The evaporator controls and equipment obtain 120-volt, single-phase power from the secondary side of a transformer, located in the control box. The primary side of this transformer is connected to two lines of the three-phase power supply; therefore, a separate 120-volt, single-phase supply is not required from the user to power the controls.

When the operating handle (located at the front right of the control box) for the disconnect switch is in the off position, power is turned off to the heat exchanger and control equipment. Line voltages for the customer-connected alarms and the three-phase power supply are present inside the control box, however, so observe the following warning when servicing the controls.



WARNING: LINE VOLTAGE IS PRESENT INSIDE THE CONTROL BOX EVEN WHEN THE PANEL POWER SWITCH IS IN THE OFF POSITION. TO AVOID POSSIBLE SEVERE PERSONAL INJURY DUE TO ELECTRICAL SHOCK, DISCONNECT EXTERNAL POWER SUPPLY BEFORE SERVICING.

2.6.2 Heat Exchanger

The heat exchanger nameplate voltage must be within the user voltage supply range corresponding to the nominal voltage labeled inside the control box above the disconnect switch. See Table 2.1. If this is not the case, the heater must be exchanged for one of the proper value. If necessary, contact your nearest Evoqua Water Technologies regional office for assistance.

NOTE: For 220 Nominal Voltage Users: If the heat exchanger nameplate voltage rating reads as either 220/240 VOLTS or 240 VOLTS, do not return the heater. This is the proper heater for this evaporator arrangement.

For 440 Nominal Voltage Users: If the heat exchanger nameplate voltage rating reads as either 440/480 VOLTS or 480 VOLTS, do not return the heat exchanger. This is the proper heat exchanger for this arrangement.

2.6.3 Hot Water Circulating Pump

A circulating pump is provided and runs continuously while the evaporator is working. The controls are designed to shut the pump off in the event of a low water level condition.

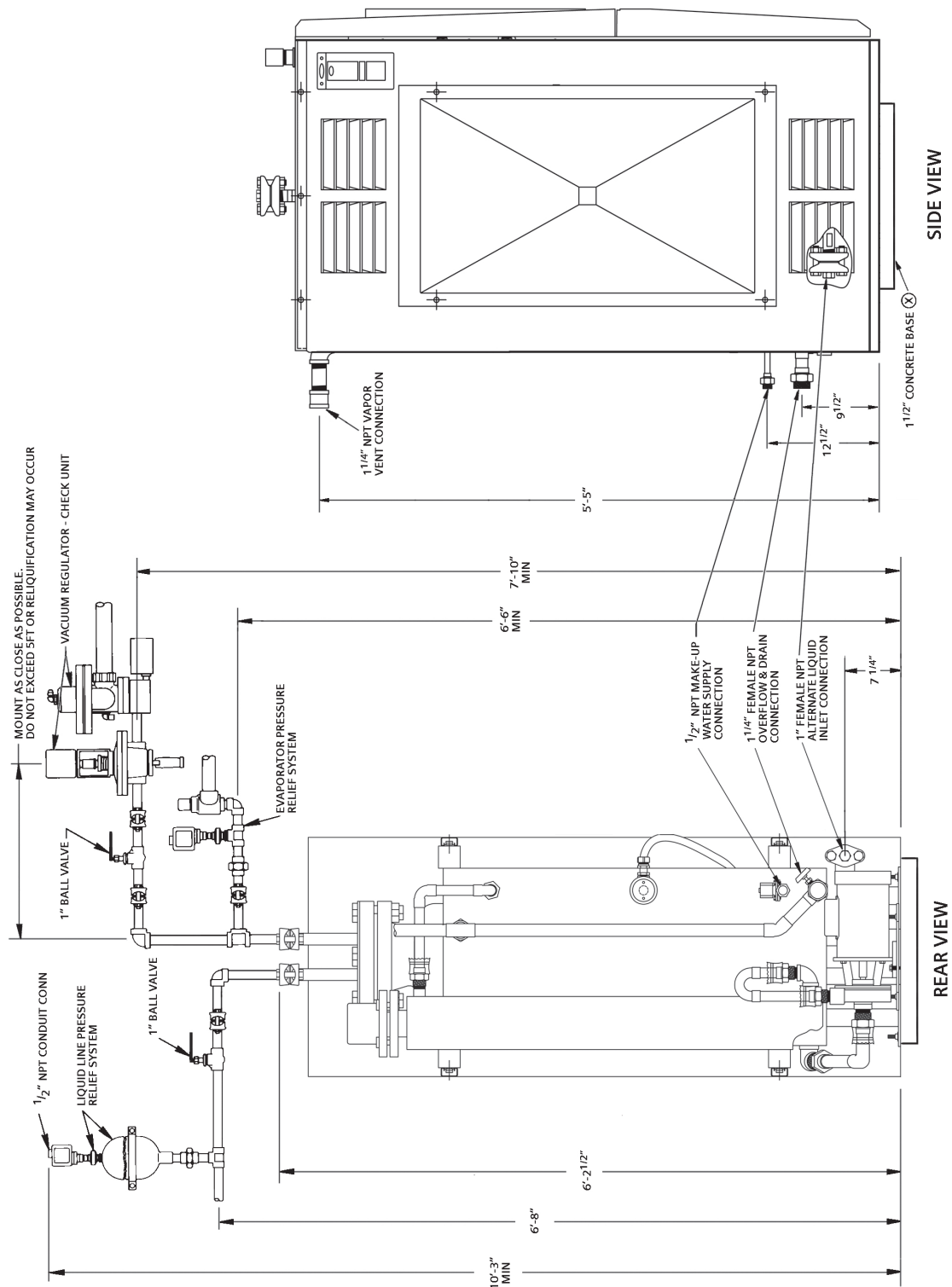
The fractional hp 50/60 Hz motor that drives the pump is a totally enclosed type, suitable for outdoor use.

2.6.4 Evaporator Gas and Liquid Line Pressure Relief Systems

Wire the pressure switch of each system directly to an alarm device or relay coil per Dwg. 50.200.130.020. The pressure switches are preset to activate at 20psi.

Every relief system, either liquid line or gas pressure relief, is supplied with the appropriate rupture disc, which is to be installed after all initial pressure testing is completed. (See paragraph 3.1, Preparation For Initial Operation.)

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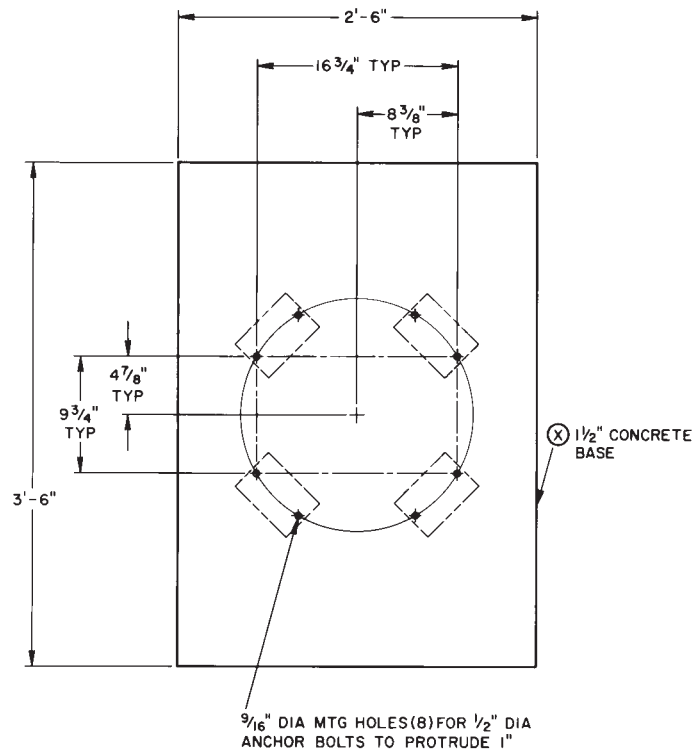


SERIES 50-200 EVAPORATOR - DIMENSIONS

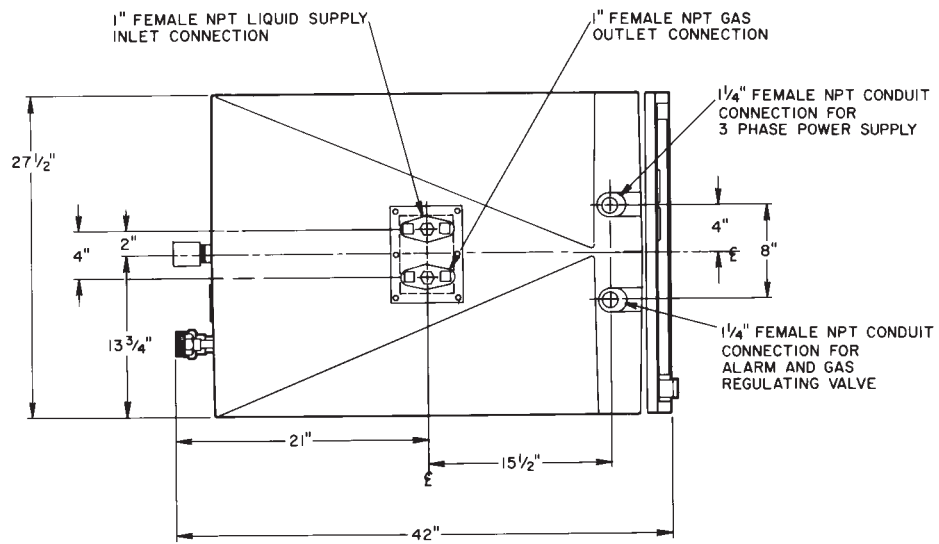
50.200.100.010A

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MOUNTING DETAIL



TOP VIEW

NOTE: **A** NOT FURNISHED BY EVOQUA WATER TECHNOLOGIES.

SERIES 50-200 EVAPORATOR - DIMENSIONS

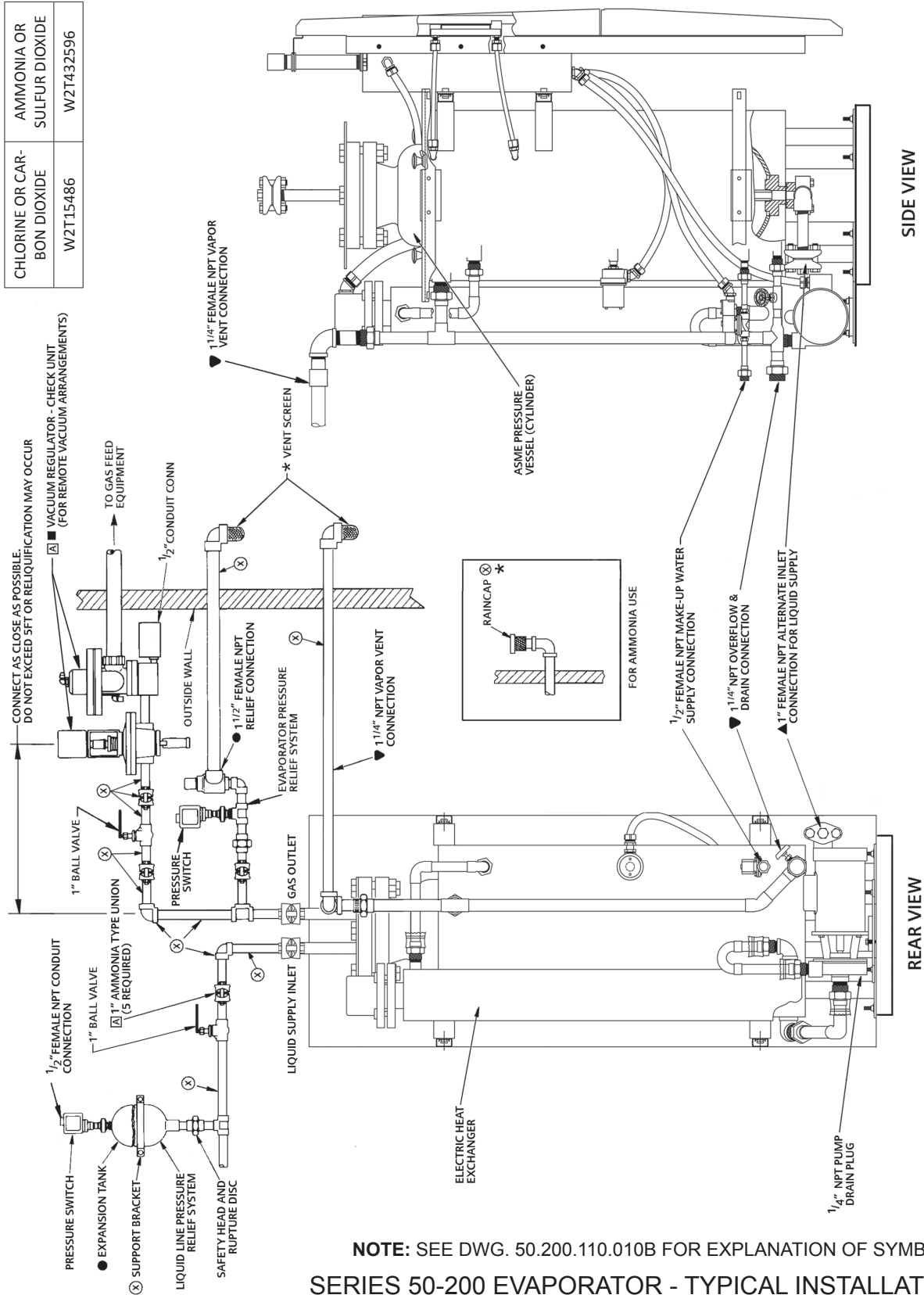
50.200.100.010B

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BALL VALVES (2)

CHLORINE OR CARBON DIOXIDE	W2T15486
AMMONIA OR SULFUR DIOXIDE	W2T432596



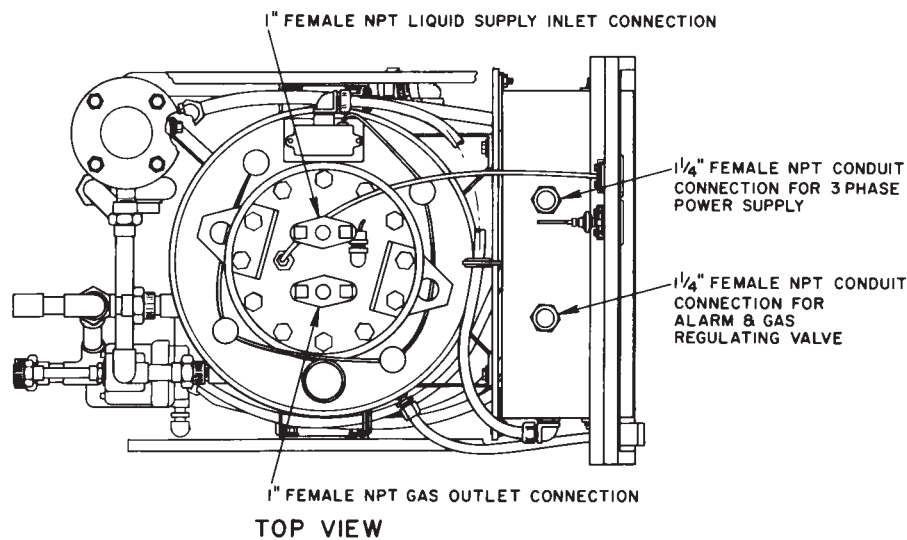
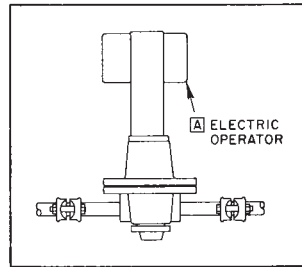
NOTE: SEE DWG. 50.200.110.010B FOR EXPLANATION OF SYMBOLS.

SERIES 50-200 EVAPORATOR - TYPICAL INSTALLATION

50.200.110.010A

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50-200 EVAPORATOR FOR CHLORINE



WARNING: TO AVOID PERSONAL INJURY FROM ACCIDENTAL EXPOSURE TO HIGH VOLTAGE, SUITABLY GROUND THE EVAPORATOR TO EARTH BEFORE START-UP.

- * 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, INC. OR THE COMPRESSED GAS ASSOCIATION, INC. FOR ALTERNATE METHOD OF RELIEF DISPOSAL.

NOTES: ▼ SURFACE TEMPERATURE MAY REACH 212°F.

A ACCESSORY ITEM FURNISHED ONLY IF SPECIFICALLY LISTED IN QUOTATION.

■ GAS PRESSURE REDUCING VALVE CAN BE FURNISHED BY EVOQUA WATER TECHNOLOGIES FOR PRESSURE SUPPLY ARRANGEMENTS.

▲ USE WHEN TWO OR MORE EVAPORATORS ARE MANIFOLDED. FOR ONE EVAPORATOR, CONNECTION MAY BE AN ALTERNATE TO TOP INLET.

● THE SYSTEM MUST BE INSTALLED WITH THE RELIEF VALVE IN A VERTICAL POSITION AND WITH THE CLOSED END OF THE EXPANSION TANK FACING UP.

(X) ALL PIPING AND FITTINGS TO BE SUPPLIED BY THE CUSTOMER. USE SCHEDULE 80 SEAMLESS CARBON STEEL PIPE WITH 3000 LB. FORGED STEEL FITTINGS.

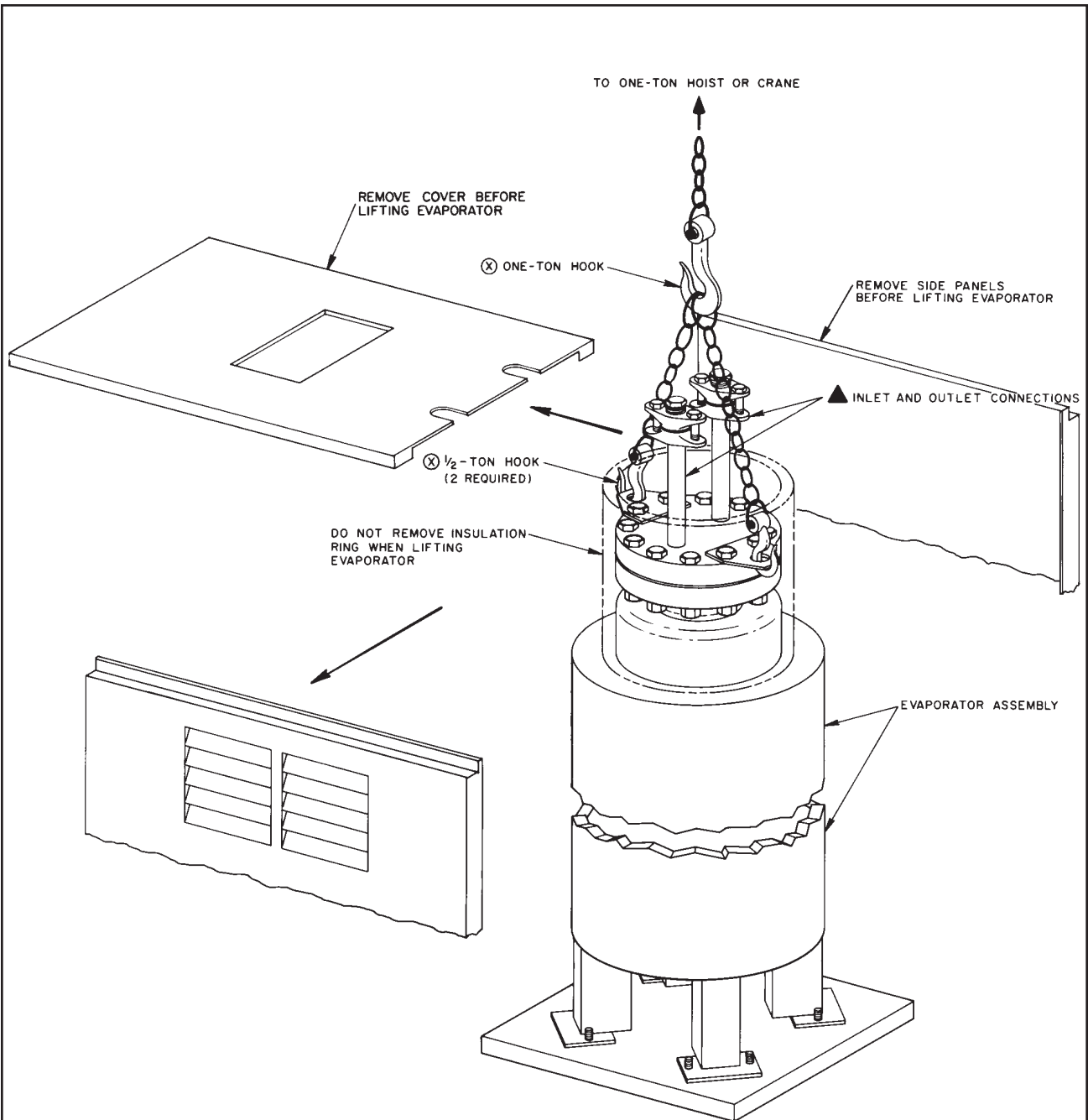
FOR REMOVAL OF CYLINDER, MINIMUM CEILING HEIGHT MUST BE 10'-0" PLUS LIFTING GEAR. FOR REMOVAL OF CABINET, ALLOW 15" MINIMUM SIDE CLEARANCE.

SERIES 50-200 EVAPORATOR - TYPICAL INSTALLATION

50.200.110.010B

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50-200 EVAPORATOR FOR CHLORINE



WARNING: ▲ TO AVOID POSSIBLE SEVERE PERSONAL INJURY AND EQUIPMENT DAMAGE, DO NOT ATTEMPT TO LIFT EVAPORATOR BY INLET AND OUTLET CONNECTIONS.

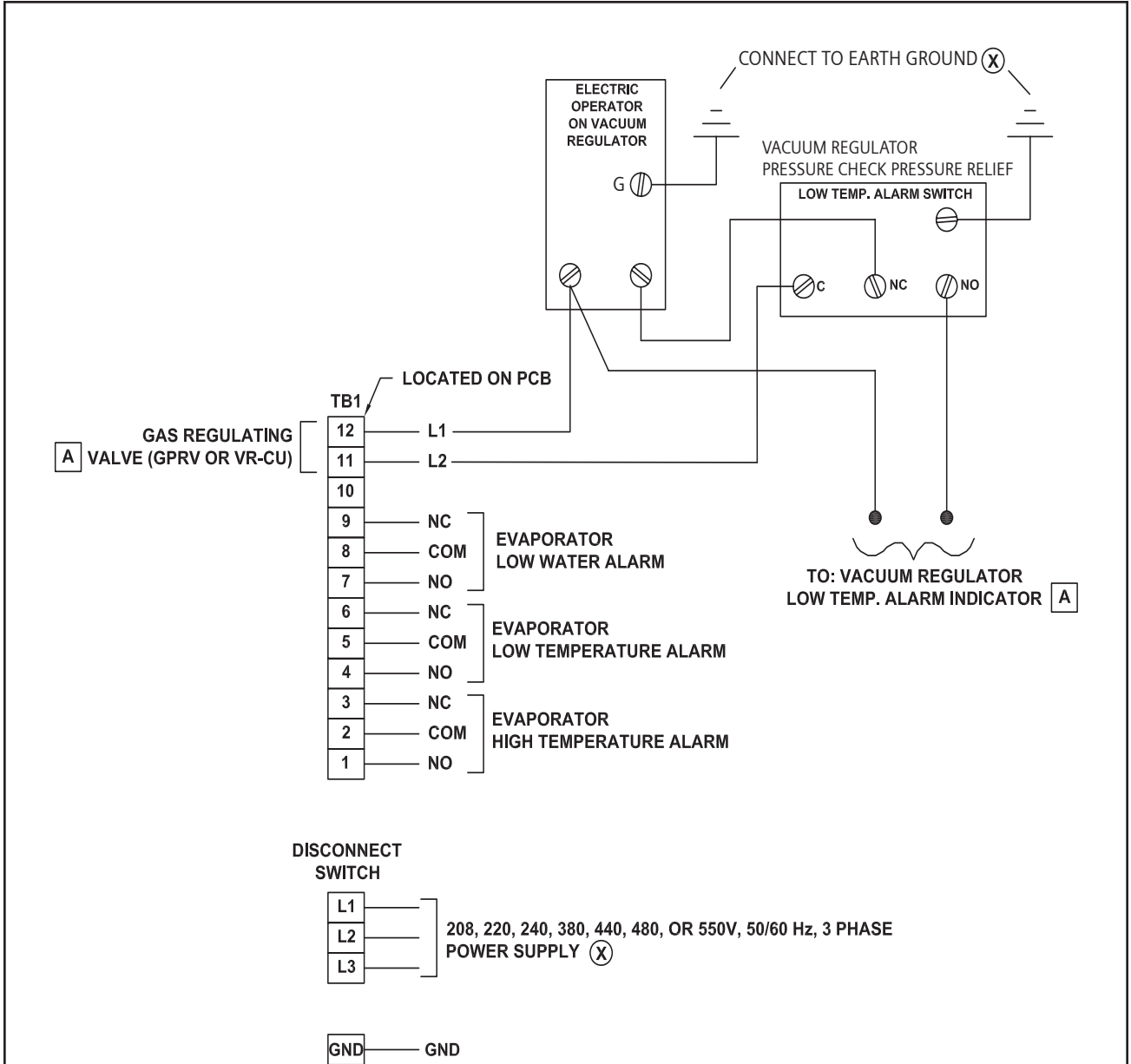
NOTE: ⊗ NOT FURNISHED BY EVOQUA WATER TECHNOLOGIES

EVAPORATOR LIFTING METHOD - INSTALLATION

50.200.110.030

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50-200 EVAPORATOR FOR CHLORINE



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

— FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

NOMINAL EVAPORATOR VOLTAGE SPECIFIED BY CUSTOMER AT TIME OF ORDER.

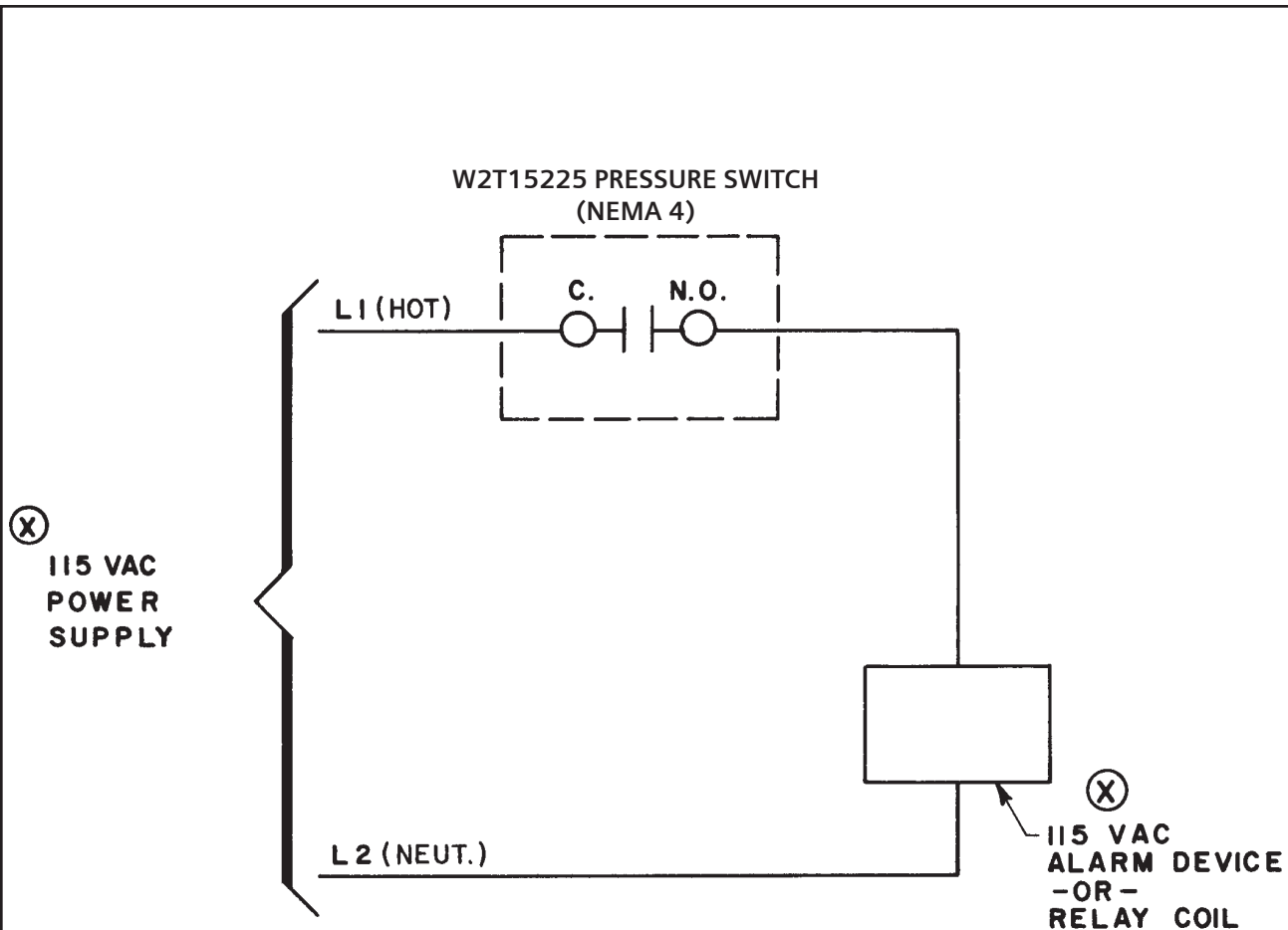
IN THE EVENT OF A LOW WATER TEMPERATURE, HIGH WATER TEMPERATURE, OR LOW WATER LEVEL CONDITION, THE "C" AND "NC" TERMINALS ARE CLOSED BY A RELAY TO COMPLETE A CIRCUIT. THEREFORE, CONNECT APPROPRIATE ALARMS TO THESE TERMINALS. THE "C" AND "NO" TERMINALS MAY BE USED TO INDICATE NORMAL OPERATION.

SERIES 50-200 EVAPORATOR - INSTALLATION WIRING

50.200.130.010

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50-200 EVAPORATOR FOR CHLORINE



NOTE: (X) NOT FURNISHED BY EVOQUA WATER TECHNOLOGIES

SERIES 50-200 EVAPORATOR - INSTALLATION WIRING
Liquid Line & Pressure Relief System - Alarm Switch

50.200.130.020

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SECTION 3

SECTION 3 - OPERATION

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Operation-Evaporator Front Panel Indicators.....	50.200.170.010

3.1 Preparation For Initial Operation

3.1.1 Controls



WARNING: FOR YOUR SAFETY AND THE SAFETY OF ALL PLANT PERSONNEL, READ AND UNDERSTAND THIS ENTIRE PREPARATION PROCEDURE AND FAMILIARIZE YOURSELF WITH THE CHLORINE HANDLING MANUAL BEFORE PERFORMING ANY WORK.

- a. Turn on the water supply to the solenoid valve.



WARNING: TO AVOID SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, USE ONLY WATER TO FILL THE HOT WATER TANK AND HEAT EXCHANGER. DO NOT USE ANY SUBSTITUTE FLUID. THE BOILING TEMPERATURE OF WATER PROVIDES A LIMIT ON AN ACCIDENTAL OVER-TEMPERATURE CONDITION, THEREBY LIMITING THE GAS PRESSURE INSIDE THE EVAPORATOR CYLINDER.

NOTE: Water supply pressure must be 10 psi minimum.

- b. Turn the power switch located on the front of the control box to ON. The solenoid valve in the water supply line will be energized and opened, admitting water to the hot water tank, pump, and heat exchanger. The LOW WATER LEVEL alarm light on the control box will go out when the water level reaches a point just above the bottom of the sightglass. At this point the circulating pump will switch on. The coil in the contactor for the heat exchanger will be energized, resulting in the raising of the temperature of the water bath. When the water level reaches normal operating height, 2/3 to 3/4 of the height of the sightglass, the water level control switch will de-energize the solenoid valve and shuts off the water supply.
- c. Check to see that the low water temperature alarm switch, labeled TS3-LOW, is set to actuate at 160°F (+10°, -5°). This switch is factory calibrated. No adjustment is necessary.

Below the tank water temperature of 160°F, the LOW TEMPERATURE alarm light on the control box will stay on. When the temperature reaches 160°F (+10°, -5°) the low temperature switch will close, causing the vacuum regulator-check unit (or gas pressure reducing valve) to open.

- d. The water bath will reach operating temperature about 45-60 minutes after start-up, depending on initial water temperature and heater capacity. The water bath temperature is controlled electronically by the printed circuit board. The control circuitry has been factory-calibrated to maintain the water temperature at approximately 180°F; adjustments are not required.

- e. The high temperature alarm switch, labeled TS2-HIGH and located next to the low temperature switch TS3-LOW, is factory calibrated. No adjustment is necessary.
- f. The pressure relief alarm switches are factory preset at 20 psi. No further adjustment of these switches is needed.



WARNING: IF ANY OF THE RESPONSES TO THE ELECTRICAL CONTROLS IN B, C, D, AND E ARE NOT OBSERVED, A FAULTY CONTROL DEVICE OR WIRING ERROR IS INDICATED. IN ORDER TO AVOID POSSIBLE PERSONAL INJURY OR EQUIPMENT DAMAGE, TAKE CORRECTIVE ACTION BEFORE PROCEEDING. SEE THE TROUBLESHOOTING GUIDE IN SECTION 4.

3.1.2 Leak Testing



WARNING: TO AVOID SEVERE PERSONAL INJURY AS A RESULT OF A CHLORINE LEAK(S), ENSURE THAT THE CHLORINATOR IS READY FOR OPERATION BEFORE CHLORINE IS INTRODUCED INTO THE EVAPORATOR AND ITS CONNECTING PIPELINES. OPERATION OF THE CHLORINATOR MAY BE NECESSARY TO DISPOSE OF CHLORINE TO PERMIT THE REPAIR OF LEAKS. IF THE EVAPORATOR IS USED WITHOUT A CHLORINATOR, PROVIDE AN ALTERNATE MEANS OF DISPOSAL.

NOTE: Do not install the rupture discs yet; wait until instructed to do so.

- a. Connect a supply of dry air or nitrogen to the evaporator supply line.
- b. Purge the system with the dry air or nitrogen to remove all moisture.



WARNING: TO AVOID SEVERE PERSONAL INJURY DUE TO A CHLORINE LEAK(S), THE SUPPLY LINE MUST BE COMPLETELY DRY AND FREE OF OIL OR GREASE. AVOID LEAK TESTING WITH WATER. STEEL PIPING WILL RAPIDLY CORRODE IF ANY MOISTURE IS PRESENT WHEN CHLORINE IS ALSO IN THE PIPE.

- c. Pressurize the system with dry air or nitrogen to 50 psi and check the pressure switches for correct operation. When the 50 psi is applied, the pressure relief alarm switch contacts will close.
- d. Vent the pressure and install the rupture discs, taking care not to let moisture enter the system.



CAUTION: When installing the rupture discs, ensure that the groove of the disc fits the mating tongue of the safety head to avoid altering the operation level of the rupture disc. Install the disc as per the instructions that accompany the rupture discs.



WARNING: TO AVOID SEVERE PERSONAL INJURY DUE TO A CHLORINE LEAK(S), INSTALL BOTH PRESSURE RELIEF SYSTEMS' RUPTURE DISCS FOR LEAK TESTING WITH DRY AIR OR NITROGEN NOW, BEFORE LEAK TESTING WITH CHLORINE LATER.

- e. Connect the evaporator inlet connection to the gas valve (rather than the liquid valve) on the chlorine supply container. This temporary connection is required to minimize the release of chlorine in the event that repairs are needed. Do not open the gas valve yet.
- f. Pressurize the system with the dry air or nitrogen supply to 150 psi and check for leaks by applying soapy water to the pipe joints. If bubbles form, a leak is present and must be corrected. If an alarm in either or both of the pressure relief systems is actuated, a leak(s) in the rupture disc(s) is indicated. If the disc is damaged, do not attempt to repair it; replace it with a new one.



WARNING: TO AVOID SEVERE PERSONAL INJURY, BE FAMILIAR WITH EMERGENCY PROCEDURES RECOMMENDED BY THE CHLORINE INSTITUTE, INC. AND ANY APPLICABLE PLANT EMERGENCY PROCEDURES FOR DEALING WITH CHLORINE LEAKS THAT DO NOT RESPOND TO NORMAL REPAIR PROCEDURES. HAVE AN APPROVED GAS MASK AVAILABLE WHEN TESTING FOR CHLORINE LEAKS.

- g. Reduce the pressure in the system to slightly below the chlorine supply pressure. Open the chlorine container gas valve and allow some chlorine gas to enter the system. Turn off the chlorine, repressurize with the dry air (or nitrogen) supply to 150 psi, and test for leaks with 26° Baume solution of ammonia. If a cloud of white mist forms when the ammonia solution is held near a pipe joint, a chlorine leak is present and must be corrected. If a leak is discovered, operate the chlorinator to dispose of the chlorine-in-air mixture. (If the evaporator is used without a chlorinator, provide an alternate means of disposal. See the warning in paragraph 3.1.2.) If no leaks are found, dispose of the chlorine-in-air mixture and proceed to the next step.
- h. Close all valves between the evaporator and the source of supply. Then slowly open the gas valve at the chlorine tank car or the ton container and test for leaks using the ammonia supplied with the evaporator. Open valves progressively, testing for leaks as each new section is filled with chlorine. If a leak is discovered, shut off the gas supply immediately, open the gas discharge line of the evaporator and operate the chlorinator to dispose of the gas. (If the evaporator is used without a chlorinator, provide an alternate means of gas disposal. See the gas disposal warning in paragraph 3.1.2.) Repair the leak before proceeding.

Moisture, including atmospheric, when combined with chlorine, forms hydrochloric and hypochlorous acids, which are highly corrosive.



WARNING: TO AVOID SEVERE PERSONAL INJURY DUE TO CHLORINE LEAKS, WHEN ANY CONNECTION IN A CHLORINE SYSTEM IS BROKEN EVEN FOR A SHORT TIME, PLUG THE OPENING IN THE SYSTEM IMMEDIATELY TO PREVENT THE ENTRANCE OF MOISTURE. PLUG THE OPENING OR USE AUXILIARY CONTAINER VALVES TO PREVENT ENTRANCE OF MOISTURE WHEN CONNECTING AND DISCONNECTING THE CHLORINE SUPPLY.

- i. After the system up to the chlorinator inlet valve has been tested and found acceptable, close the gas supply valve and run the chlorinator to exhaust the gas in the evaporator and in the inlet line. When the evaporator pressure gauge reads zero, the evaporator chlorine outlet valve may be closed. If the evaporator pressure gauge shows pressure after the outlet valve has been closed for several minutes, repeat the above procedure until the evaporator pressure gauge holds zero. When this is done, disconnect the piping from the gas valve and connect it to the liquid valve on the supply container. With the evaporator water bath adequately filled and up to operating temperature (approximately 180°F), open the liquid valve slowly and check this new connection for leaks.



WARNING: ONCE THE LIQUID SUPPLY VALVE HAS BEEN OPENED, ALL VALVES IN THE LIQUID SUPPLY LINE MUST BE LEFT OPEN UNTIL EITHER THE SUPPLY OF LIQUID HAS BEEN EXHAUSTED OR THE SUPPLY LINE AND EVAPORATOR ARE BEING EMPTIED BY THE CHLORINATOR OR OTHER MEANS OF DISPOSAL. FAILURE TO FOLLOW THIS PROCEDURE MAY RESULT IN AN OVERPRESSURE CONDITION AND DISCHARGE OF GAS FROM THE RELIEF SYSTEM.

3.1.3 Cathodic Protection System

Sodium sulfate is added to the water bath to increase its conductivity, thus aiding in the start of the cathodic protection process. Observe and follow these instructions:

- a. Remove the caplug covering the 2-3/4-inch hole in the top of the tank.



WARNING: THE TOP OF THE TANK WILL BE HOT (180°F). TO AVOID SEVERE PERSONAL INJURY DUE TO HOT SURFACES, DO NOT REMOVE OR REINSTALL CAPLUG WITH BARE HANDS; USE A GLOVE OR OTHER INSULATING MATERIAL.

- b. Add 1/4 lb. (approximately 1/4 of the bottle provided) of sodium sulfate to the water bath when starting up for the first time. For best results, dissolve 1/4 lb. of sodium sulfate in one or two quarts of water and pour this solution into the water tank.
- c. Replace caplug (See above warning.)

NOTE: Due to the insulating quality of the chlorine cylinder paint finish, there may be little or no initial reading on the milliammeter. If a reading is now observed, adjust the potentiometer located next to the milliammeter on the front of the control box to obtain a reading between 25 and 50% on the meter. See Dwg. 50.200.170.010. If the needle remains on zero, check the cathodic protection system's electrical connections. Before opening the control box to check connections, observe the following warning.



WARNING: LINE VOLTAGE IS PRESENT AT THIS LOCATION EVEN WHEN THE PANEL POWER SWITCH IS IN THE OFF POSITION. TO AVOID POSSIBLE SEVERE PERSONAL INJURY DUE TO ELECTRIC SHOCK, DISCONNECT THE EXTERNAL POWER SUPPLY BEFORE SERVICING.

- d. If, after six months to one year, the milliammeter shows no reading, add another 1/4 lb. of sodium sulfate. If the water bath is drained, add 1/4 lb. of chemical on refill and adjust for a 25 to 50% reading.

NOTE: One-quarter lb. of chemical is all that is required at each addition of chemical. Using more than 1/4 lb. will not increase the efficiency of the cathodic protection system.



CAUTION: Always replace caplug after adding sodium sulfate solution. This will prevent the introduction of foreign objects or substances into the water bath.

3.1.4 Enclosure

Replace the enclosure on the evaporator. The evaporator is now ready for operation. Refer to Dwg. 50.200.060.030.

3.2 Operation

3.2.1 Startup

When the procedures in paragraph 3.1, Preparation For Initial Operation, are completed, the water bath will be at the operating temperature of 180°F. Slowly open the evaporator liquid supply valve. Open the outlet valve of the evaporator and put the chlorinator in service.

3.2.2 Operating Routine

Regular observation of the evaporator function indicators and alarm lights will enable the operator to verify that the evaporator is working properly.

- **EVAPORATOR PRESSURE GAUGE:** The gauge indicates the pressure inside the evaporator cylinder, which is also the equilibrium pressure inside the chlorine supply container corresponding to the temperature of the chlo-

rine liquid. If a blockage develops or a valve is closed while chlorination is stopped, the pressure will increase substantially. Normal operating pressure is 30 to 140 psi. If the pressure rises into the 180 to 200 psi range, take corrective action. Refer to the Troubleshooting guide, Symptoms Group 2, in Section 4. The pressure gauge is designed for exposure up to 600 psi without loss of calibration.

- **WATER TEMPERATURE METER:** The meter indicates the water bath temperature. Normal operating temperature is approximately 180°F.
- **CONTROL BOX ALARM LIGHTS:** The front of the control box contains three alarm lights and one power indicator light. The red HIGH TEMPERATURE alarm lights will go on when the water bath temperature exceeds 200°F. The orange LOW TEMPERATURE alarm light will illuminate when the water bath temperature drops below 160°F. If the water level drops below the bottom of the sightglass, the red LOW WATER LEVEL alarm light will come on.

NOTE: When the evaporator is turned on after short-term shutdown and the water is at normal operating level, the LOW WATER LEVEL alarm light will remain on for several seconds. Then the circulating pump will turn on. This pause is a part of the normal control operations of the evaporator.

- **CATHODIC PROTECTION AMMETER:** Refer to paragraph 3.1, Preparation For Initial Operation. The meter may not indicate current for the first several months of service. Normal operating current is between 50 and 250 milliamps. If it exceeds this value, it may be reduced by turning counterclockwise the knob located to the right of the milliammeter. If the current is allowed to rise above 250 milliamps, the anodes of the cathodic protection system will not last as long as they would if the reading is maintained. The 50- to 250-milliamps reading assures full protection. More than 250 milliamps unnecessarily consumes anodes.
- **WATER LEVEL SIGHTGLASS:** The sightglass provides a direct indication of water bath level. If a LOW WATER LEVEL alarm light or separate alarm actuates, observation of the sightglass will confirm the low level condition or indicate a low water level switch malfunction. The normal operating level in the sightglass tube, as maintained by the automatic water level control, is 2/3 to 3/4 full. Low water level is approximately 1/8 full or less.
- **OBSERVATION OF NEED FOR CYLINDER CLEANING:** A build-up of impurities in the evaporator cylinder will result in gradual loss of heat transfer and loss of evaporating capacity. An obvious indication of this will be a cooling of the pipe coming from the outlet of the vacuum regulator-check unit (or gas pressure reducing valve). This cooling can be sensed by touching the pipe or observing condensation of frost on the outlet pipe.



WARNING: TO AVOID DAMAGING THE INTERNAL PLASTIC COMPONENTS OF THE CHLORINATOR, OR TO AVOID SEVERE PERSONAL INJURY CAUSED BY THE RELEASE OF CHLORINE GAS, BE CERTAIN THAT NO LIQUID CHLORINE EXISTS IN CHLORINATOR ROTAMETER TUBE. IF CHLORINE LIQUID IS PRESENT IN THE ROTAMETER TUBE, IMMEDIATELY SHUT DOWN THE EVAPORATOR BY FOLLOWING THE CYLINDER EVACUATION PROCEDURES IN PARAGRAPH 3.2.3B. REFER TO SECTION 4 FOR CYLINDER CLEANING INSTRUCTIONS.

The need for cylinder cleaning can also be determined by observing the gas temperature gauge on the front panel next to the pressure gauge. The gas temperature gauge will show a drop in gas temperature at a given pressure and rate of withdrawal as impurities are deposited inside the chlorine cylinder. With some experience, the operator can use this indication to determine when the evaporator will need cleaning. As long as there are no blockages or closed valves between the evaporator and the supply, the pressure within the evaporator cylinder is the same as the pressure in the tank car or ton container, which in turn is a function of the temperature of the liquid chlorine in the tank car or ton container. By reading the pressure gauge for the evaporator cylinder, a close approximation of the liquid chlorine temperature can be obtained by referring to the temperature/pressure scale on the face of this gauge.

After evaporation at this temperature, the chlorine will pick up heat during its passage through the evaporator. The additional heat picked up is called "Superheat". The amount of superheat at a particular time is function of the difference in temperatures between the water bath and the liquid chlorine, the efficiency of heat transfer through the wall of the chlorine cylinder and the rate of withdrawal of gaseous chlorine. The face of the pressure gauge is graduated for pressure and the equilibrium (evaporating) temperature at that pressure. Using the gas temperature gauge, an approximate value of superheat can be obtained by reading the pressure and gas temperature gauge. For example, the pressure is 85 psi and temperature is 87°F. Reference to the temperature scale on the pressure gauge will show that the equilibrium (evaporating) temperature for a pressure of 85 psi is 70°F. Since the actual gas temperature is 87°F, the superheat is 17°F. It will be observed that a decrease in the withdrawal rate will result in an increase in superheat. Likewise, increasing the withdrawal rate will result in a decrease in superheat.

In general, as long as there is some superheat, the evaporator is functioning properly. By periodically recording the superheat at a given chlorine feed rate and water bath temperature, the plant operator has an indication of the condition of the inside of the chlorine cylinder. Contaminants in the liquid chlorine tend to accumulate in the evaporator cylinder and deposit on the inside wall, thus reducing heat transfer from the water bath. When sufficient impurities have collected to result in insufficient heat transfer, the superheat will have dropped close to zero and liquid chlorine will begin

passing through the evaporator outlet, resulting in a hazardous condition of operation. Therefore, a periodic record of superheat will permit the operator to schedule the cleaning of the evaporator well in advance. As noted previously, the evaporator is functioning properly as long as there is some superheat. Due to tolerance in gauges, the first cleaning of a new evaporator should be scheduled when the superheat has dropped to about 10°F. Examination of the interior of the cylinder when the head (upper flange) is removed for cleaning can guide the operator in judging what value of superheat should be used as a criterion for further cleanings.

NOTE: The specific pressure/temperature values used in this example were obtained from the Chlorine Manual, published by the Chlorine Institute, Inc.

3.2.3 Shutdown

- Short-Term Shutdown.
 - a. Close the evaporator outlet valve. When the outlet valve is closed, gas will form inside the cylinder, pushing liquid back to the supply container.
 - b. If the supply container does not have adequate reserve capacity to accept the maximum contents being forced from the evaporator cylinder, do not stop chlorination.



WARNING: TO AVOID RUPTURE OF THE SUPPLY CONTAINER, CAUSING POSSIBLE SEVERE PERSONAL INJURY, CLOSE THE SUPPLY VALVE AND USE THE CHLORINATOR OR GAS DISPOSAL SYSTEM TO COMPLETELY EVACUATE THE EVAPORATOR CYLINDER AND ITS CONNECTING PIPELINES.

NOTE: The warning above applies if a situation is created, for example, where a new, capacity-filled supply is connected to the evaporator and the previous supply is disconnected or closed. If a liquid supply valve is then closed, after additional liquid is forced into the capacity-filled supply container, pressures capable of rupturing the container will develop with a slight increase in temperature.

- c. If the supply container can accept the maximum contents without exceeding its rated capacity, the outlet valve can remain closed throughout the short-term shutdown; however, do not shut any valves in the chlorine supply piping. With the evaporator outlet closed or with chlorination stopped, as long as the inlet valve to the evaporator and the valves to the ton container or tank cars are open, the pressure within the evaporator cylinder is limited to never exceeding the pressure in the ton container or tank car.



WARNING: TO AVOID AN OVERPRESSURE CONDITION THAT MAY RESULT IN A DISCHARGE OF GAS FROM THE GAS PRESSURE RELIEF SYSTEM, DO NOT CLOSE ANY VALVE OR VALVES BETWEEN THE EVAPORATOR AND THE CHLORINE SUPPLY WITHOUT FOLLOWING THE EVACUATION PROCEDURE DESCRIBED IN STEP B, BELOW. LIQUID CHLORINE HAS A HIGH COEFFICIENT OF THERMAL EXPANSION. DO NOT CLOSE VALVES IN SUCH A WAY THAT LIQUID CHLORINE MAY BE TRAPPED, SINCE DANGEROUS PRESSURES CAPABLE OF RUPTURING THE PIPING SYSTEM MAY BUILD UP WITH A SMALL INCREASE IN TEMPERATURE.

- d. Re-open the gas outlet valve to resume evaporator operation.
- Long-Term Shutdown.
 - a. Follow the instruction for Short-Term Shutdown, steps a, b, and c. If the liquid can be safely pushed back to the supply container, shut the evaporator outlet valve for a period of approximately 30 minutes. Under these conditions, most of the liquid chlorine will be forced back to the supply tank through the nipple and remaining liquid will be evaporated by the heat of the water bath.
 - b. At the end of this period, shut the supply valve at the tank car or the ton container; immediately open the evaporator outlet valve and run the chlorinator to exhaust the gas in the evaporator and the gas and liquid in the inlet line.
 - c. When the evaporator pressure gauge reads zero, the chlorine outlet valve may be closed.
 - d. If the evaporator pressure gauge shows pressure after the outlet valve has been closed for several minutes, repeat steps a through c until the evaporator pressure gauge reads zero with outlet valve closed. Then turn off power to the control box and alarm units.
 - e. If no standby evaporator is being used, shut down the chlorinator.
 - f. Drain the hot water tank by opening the drain valve at the back of the unit.
 - g. Drain the heat exchanger by removing the 1/2-inch plug at the bottom (underside) of the heat exchanger. A small container may be used to capture the water (approximately 1/2 gallon) when the plug is removed.



WARNING: TO AVOID SEVERE PERSONAL INJURY WHEN HOT WATER DRAINS OUT OF HEAT EXCHANGER, ALLOW WATER TO COOL BEFORE REMOVING PLUG.

- h. Replace the plug after the water has completely drained from the heater. Remove the 1/4 NPT plug at the bottom of the pump impeller housing (Dwg. 50.200.110.010 in Section 2). Allow the pump to drain thoroughly before replacing the plug.



CAUTION: The pump and heat exchanger must be drained to prevent corrosion build-up during long-term shutdown.

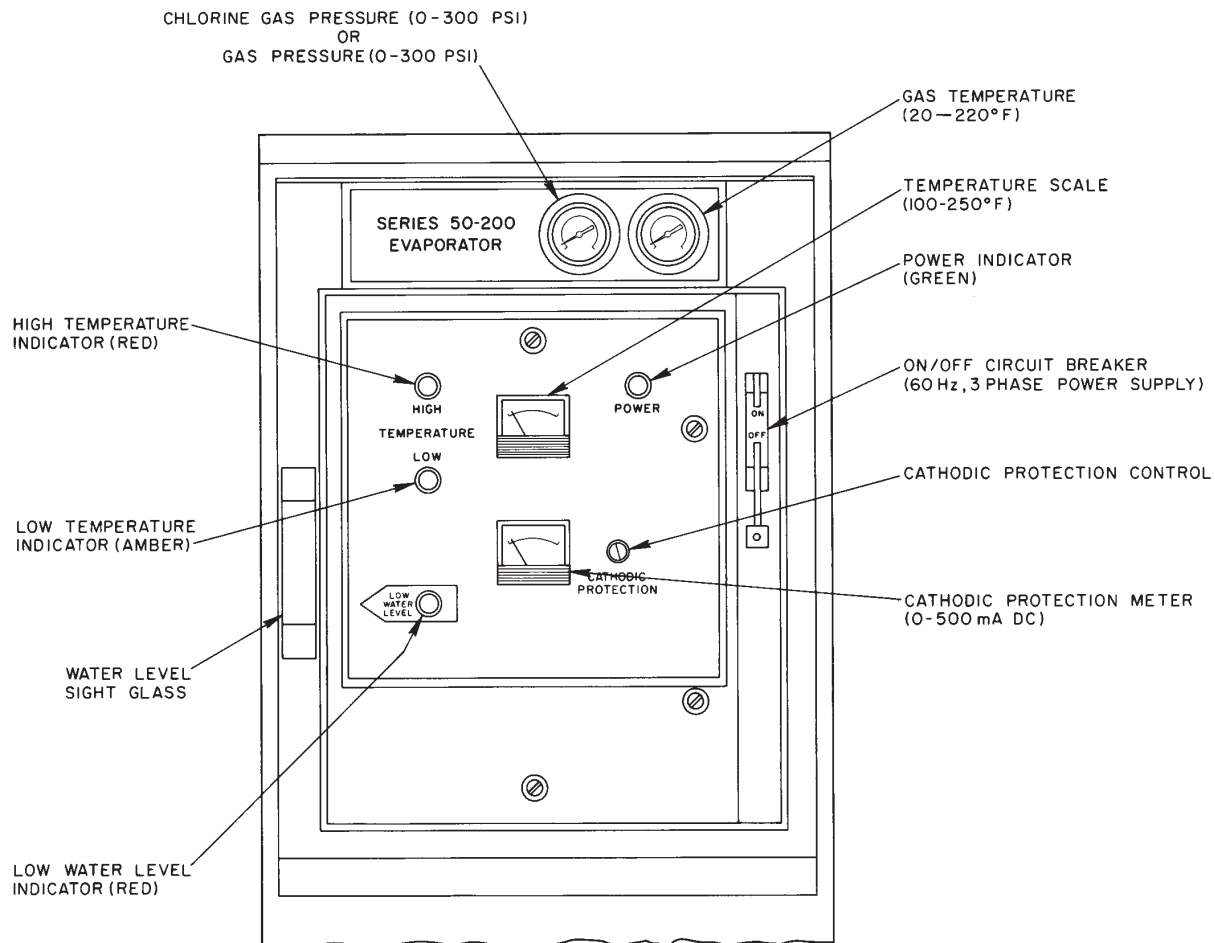
3.3 Theory Of Operation

Liquid chlorine from the source container is piped to the evaporator chlorine cylinder. This cylinder is immersed in a temperature-controlled hot water bath. Liquid enters the cylinder through the top, but a drop pipe inside carries the liquid almost to the bottom. The alternate inlet connection at the bottom has a riser that terminates at approximately the same level as the end of the drop pipe. Thus, the liquid chlorine enters near the bottom of the cylinder and the vapor leaves from a point somewhat below the top, as the discharge connection also has a short drop pipe. This arrangement limits cylinder pressure to that of the source container and prevents the complete filling of the cylinder with liquid chlorine. The heat transfer surface in the gas-filled portion of the cylinder superheats the chlorine vapor.

When the entering liquid chlorine contacts the hot inner surface of the evaporator cylinder, it boils inside this cylinder. When sufficient gas has formed to satisfy the demand of the chlorination process, the incoming liquid chlorine flow stabilizes because the pressure in the evaporator cylinder and supply container have equalized. If too much liquid enters the evaporator cylinder, more gas is formed than is required by the chlorination process. The evaporator cylinder pressure rises above that of the supply container, causing some liquid chlorine to be forced back into the supply container until the pressure in the evaporator cylinder and supply container have again equalized. Therefore, as long as the line to the supply container is open, the liquid level in the evaporator cylinder is automatically adjusted by the rate of gas used. If no gas is withdrawn, the evaporator will empty itself as the gas formed pushes the liquid back to the supply container. When the liquid level falls below the end of the inlet pipe, it is pushed back to the supply container by gas until no liquid remains. Conversely, if more gas is called for than a particular liquid level is able to generate, the liquid level will rise, causing more liquid to change to gas to meet the demand.

NOTE: For detailed description of control equipment, refer to Section 4 - Service.

50-200 EVAPORATOR FOR CHLORINE



EVAPORATOR FRONT PANEL INDICATORS - OPERATION

50.200.170.010

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SECTION 4

SECTION 4 - SERVICE

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4.1 General



WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY FROM EXPOSURE TO CHLORINE, REVIEW THE CHLORINE HANDLING MANUAL BEFORE BREAKING ANY CHLORINE CONNECTIONS.

Piping leaks are usually caused by either improperly assembling pipe joints or reusing gaskets.



WARNING: LINE VOLTAGE IS PRESENT INSIDE THE CONTROL BOX. TO AVOID POSSIBLE SEVERE PERSONAL INJURY FROM ELECTRICAL SHOCK, DEACTIVATE EXTERNAL POWER SOURCE(S) BEFORE OPENING THE CONTROL BOX.



WARNING: TO REDUCE THE POSSIBILITY OF CHLORINE LEAKAGE, ASSEMBLE ALL THREADED JOINTS IN ACCORDANCE WITH THE CHLORINE HANDLING MANUAL. DO NOT REUSE GASKETS; ALWAYS USE NEW GASKETS.



WARNING: TO AVOID SEVERE PERSONAL INJURY, WHEN ANY PIPING CONNECTION IS BROKEN, EVEN FOR A SHORT PERIOD OF TIME, PLUG THE RESULTANT OPENING IMMEDIATELY TO PREVENT THE ENTRANCE OF MOISTURE. MOISTURE, INCLUDING ATMOSPHERIC, WHEN COMBINED WITH CHLORINE, IS HIGHLY CORROSIVE TO PIPING. WHEN CHANGING CHLORINE SUPPLY CONTAINERS, PREVENT THE ENTRANCE OF MOISTURE INTO THE CHLORINE PIPING BY PLUGGING OPEN ENDS OR USING AUXILIARY TON CONTAINER VALVES.

4.1.1 Inspection

When performing preventive maintenance or servicing of the evaporator, perform the following inspection routine:

- a. Check for any physical damage to removed parts (chipped, cracked, damaged threads; excessive corrosion). Replace all damaged components.
- b. Discard and replace all removed gaskets, seals, and O-rings.

NOTE: Refer to Section 6 for a list of approved Evoqua Water Technologies spare parts.

4.2 Temperature Control and Indication

The tank water temperature is sensed by an electronic temperature probe immersed in the water bath. The probe is mounted in the probe housing block located on the top of the hot water tank. The electronic signal from the probe is processed by the printed circuit board to control the operation of the heat

exchanger and to indicate the water temperature on the analog meter on the front of the control box. This circuitry has been factory-calibrated; adjustments are not required. Refer to the Troubleshooting Guide in case of malfunction.

4.3 High and Low Temperature Switches

This is a dual temperature switch that senses the water bath temperature directly at the tank. The low temperature switch (TS3-LOW) is set to 160°F; the high temperature switch (TS2-HIGH) is set to 200°F. The switches are rated for 10 amperes at 120 VAC and 30 VDC. Alarm connections for the switches are located on the printed circuit board inside the box.

4.4 Relief Systems Pressure Switches

This single-setting pressure sensing device is pre-set for 20 psi at the factory and requires no readjustment. The switch is rated at 10 amperes for 125 or 250 Vac.

Should the pressure switch (W2T15225) function improperly on either the liquid line pressure relief system (W3T99062) or the pressure relief system (W3T97782), proceed as follows:



WARNING: TO AVOID A MAJOR RELEASE OF CHLORINE, CAUSING POSSIBLE SEVERE PERSONAL INJURY, DO NOT REMOVE THE PRESSURE RELIEF SYSTEM WHILE THE EVAPORATOR IS PRESSURIZED. BEFORE ATTEMPTING TO SERVICE THE PRESSURE RELIEF SYSTEM, FOLLOW STEPS A(1), A(2) AND A(3) IN PARAGRAPH 4.12.

If after performing steps a1, a2 and a3 in paragraph 4.12, the pressure switch remains actuated, chlorine under pressure is still present in the pressure relief system. This indicates a leaking (not ruptured) rupture disc.



WARNING: TO AVOID SEVERE PERSONAL INJURY DUE TO INHALATION OF CHLORINE GAS, USE AN APPROVED GAS MASK AND VENTILATION EQUIPMENT WHEN REMOVING THE RUPTURE DISC.

- a. Turn off the evaporator controls, alarm unit power supplies, and power to the alarm circuit being serviced. Ensure that the chlorine supply valve will remain closed while work is in progress.
- b. Remove the front cover from the pressure switch and disconnect the alarm wiring and electrical conduit from the switch's terminals.

NOTE: The relief system pressure switch is protected from corrosion by an oil-filled diaphragm capsule.



CAUTION: Do not disturb the threaded connections between the pressure switch and this capsule, as a loss of oil will cause the pressure switch to malfunction or become inoperative.

- c. Remove the pressure switch-diaphragm capsule assembly from the pressure relief system at the point where the diaphragm capsule bottom connection and the expansion tank reducing bushing meet. Do not remove the reducing bushing from the expansion tank, as this is a permanent joint.
- d. Using the Resistance Mode, connect a volt/ohmmeter across the “C” (Common) and “NO” (Normally Open) terminals.
- e. Connect the pressure switch-diaphragm capsule assembly to a controlled pressure source. Install a calibrated pressure gauge in the line to the source.
- f. Raise and lower the pressure to determine if the switch is functioning properly and at what pressure the switch closes.
- g. The pressure switch should be able to close repeatedly on a rising pressure at 15 to 20 psi. If it does not, adjust the response point by turning counter-clockwise the knurled nut on the switch located below the microswitch. Repeat step f and this step to confirm proper actuating pressure.
- h. Reconnect the alarm wiring and the conduit to the switch and replace the front cover.
- i. Energize the alarm portion of the electrical circuit.

4.5 Automatic Water Level Control and Low Level Switches

Water level is sensed by four stainless steel probes (one common, one low level, and two differential service) mounted in the probe housing block on the top of the tank. Two independent switches are actuated by these probes. The differential service probes actuate the Automatic Water Level Control Switch filling the evaporator hot water tank $\frac{2}{3}$ to $\frac{3}{4}$ of the height of the sightglass and will refill the tank when the water level has dropped to about two inches or more below this position. The Low Water Level switch will operate just before the water level drops below the sightglass. The probe lengths are pre-cut and no adjusting is required.

Periodically clean the sightglass tube in the water level indicator on the front panel so that the water level can be easily seen. The tube is easily accessible after removing the plastic indicator cover.



WARNING: TO AVOID SEVERE PERSONAL INJURY FROM BURNS DUE TO THE HOT WATER IN THE SIGHTGLASS TUBE, TURN THE POWER OFF AND DRAIN THE TANK ENOUGH SO THAT NO WATER IS VISIBLE IN THE SIGHTGLASS. ALLOW THE SIGHTGLASS TO COOL BEFORE HANDLING.

4.6 Electrical System Checks

Make electrical checks described in paragraphs 4.6.1 and 4.6.2.



WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY DUE TO EQUIPMENT MALFUNCTION, SEMI-ANNUALLY MAKE A COMPLETE ELECTRICAL CHECK OF THE OPERATION OF THE TEMPERATURE, WATER LEVEL, AND PRESSURE RELIEF ALARM SWITCHES. IF THE APPROPRIATE RESPONSE IS NOT OBSERVED, REPLACE THE FAULTY CONTROL UNIT.

4.6.1 Temperature Switches

The high and low temperature switches are factory calibrated. No adjustment is necessary.

4.6.2 Water Level Switch and Low Level Switch

- a. Drain the water to below the sightglass and allow it to refill. If level control is working properly, it will refill automatically and the low level alarm will activate and reset.
- b. Close drain tightly when testing is completed.

4.6.3 Pressure Switch (Evaporator Relief System)

- a. Remove the switch cover.
- b. Using a thin screwdriver, operate the microswitch and observe operation of the alarm.



WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY FROM ELECTRICAL SHOCK, BE CAREFUL NOT TO TOUCH THE METAL SCREWS ON THE TERMINALS. THEY ARE CONNECTED TO 115 VOLTS.

- c. Replace the switch cover when testing is completed.

4.7 Cathodic Protection System

The 50-200 Evaporator utilizes a sacrificial cathodic protection circuit to protect the cylinder and water tank from corrosion (refer to dwg. 50.200.140.010). The ideal current is between 50 and 250 milliamps. On a new evaporator, the anodes will last well over a year. A lower milliamp current reading on a new evaporator is normal as the paint protecting the cylinder often limits the cathodic protection current. As the paint on the cylinder deteriorates the flow of current will increase.

An annual inspection of the cathodic protection anodes will, under normal conditions, show that the anodes are almost expended. Replace the four magnesium anodes. After the first replacement, they should be replaced annually.

Before new anodes are installed, it is recommended that the water be drained from the system and an inspection of the tank and cylinder be made. Sludge formed by the corrosion of the anodes should be flushed from the hot water tank and discharged through the water overflow line.

If the cathodic protection system has been operated in the recommended range, little or no corrosion will be found. Add fresh water after the new anodes have been installed. The cathodic current can be increased by adding 1/4 pound of sodium sulfate, U23934, or decreased by adjusting the potentiometer on the evaporator control panel. If a current above 250 milliamps is maintained the anodes will deteriorate quickly and the anode debris will be too large to be washed out of the water tank drain.

4.7.1 Anode Removal

The anodes can be replaced during the annual inspection. The Evaporator should be shut down by following section 4.12, "In Place" Cleaning of the Evaporator Cylinder, to and including step a(3). Continue by performing the following: Refer to dwg. 50.200.060.010.

- a. Grasp the anode knob (111) and lift the anode (114) above the top of the water tank.
- b. When the anode (114) is exposed hold it with pliers so it can not spin and unscrew the knob (111).
- c. Lift off the wire lugs and washer (112).
- d. Withdraw the old anode (114) completely and discard.
- e. Repeat this process for the other three anodes (114).

4.7.2 Anode Installation (Refer to dwg. 50.200.060.010)

- a. Place a new anode (114) into the grommet (110) on the top of the water tank, taking care not to let the anode drop below the top of the water tank.
- b. Put the washer (112) and the wire lugs onto the knobs (111) threaded post and screw the knob (111) into the anode (114).
- c. Grasp knob (111) and lower anode so it is supported by the grommet (110).
- d. Repeat step c for the other three anodes.

- e. Refer to dwg. 50.200.060.020. When the tank is full of water the cathodic protection mA meter (7) should indicate a current of between 50 and 250 milliamps. The cathodic current can be increased by adding 1/4 pound of sodium sulfate, W2T15555, or decreased by adjusting the potentiometer (10) on the evaporator control panel. If a current above 250 milliamps is maintained the anodes will deteriorate quickly and the anode debris will be too large to be washed out of the water tank drain.

4.8 Power and Alarm Lights on Control Box

The lamps inside the power and alarm lights on the control box are rated for 5000 hours of life, therefore, they will eventually burn out. See Section 6, Spare Parts List, for information on ordering replacement bulbs. The recommendation for bulb replacement is as follows:

- a. Perform the Short Term Shutdown in section 3.2.3, a-c.
- b. Turn off the incoming 3-phase power at the evaporator controls enclosure via the enclosure door latch switch (9, Dwg. 50.200.060.020).
- c. Unscrew appropriate indicator light lenses.
- d. Push in on bulb and turn counter clockwise to align tabs on bulb base with slot in bulb housing base.
- e. Withdraw bulb from housing.
- f. Insert new bulb.
- g. Screw on appropriate indicator light lenses.
- h. Reapply 3-phase power at the evaporator controls enclosure via the enclosure door latch switch (9, Dwg. 50.200.060.020).
- i. Perform the Startup in section 3.2.1.

4.9 Hot Water Circulating Pump

The manufacturer of the pump has made two repair kits available for the pump:

- Pump housing seal kit
- Shaft seal kit.

Part numbers for these kits are found in the Section 6, Spare Parts List.

The pump is the end-suction type. If the evaporator is to be shut down for an extended period of time, remove the plug at the bottom of the pump impeller housing to fully drain the pump.



CAUTION: Failure to fully drain the pump could lead over time to corrosion build-up and permanently damage the pump.

Replace plug after draining.

4.10 Evaporator Pressure Relief System

A pressure relief system conforming to ASME Boiler and Pressure Vessel Code recommendations is supplied with the evaporator. This pressure relief system consists of a rupture disc (rupture point 400 psi), a pressure switch (set at 20 psi), and a pressure relief valve (set at 560 psi). The evaporator will not, under normal operating conditions, reach these pressures, but in abnormal circumstances, such as a closed inlet and outlet valve, these pressures could develop. The alarm actuates when the disc ruptures or develops a leak. This alarm serves as a signal that conditions exist that can cause gas to be relieved out of the system. A Pressure Relief System Alarm indicates that the evaporator system requires immediate corrective attention.



WARNING: TO AVOID SEVERE PERSONAL INJURY, BE FAMILIAR WITH EMERGENCY PROCEDURES, TROUBLESHOOTING PROCEDURES, AND SERVICE SO THAT PROMPT AND EFFECTIVE ACTION CAN BE TAKEN.

Overpressure in the evaporator cylinder can result from a closed outlet valve or stopping of the chlorinator in conjunction with a blockage in the liquid inlet line, a closed valve in the liquid inlet line, or excessive “air padding” of tank cars. If the pressure relief system alarm actuates, the cause must immediately be determined and corrected. Refer to the Troubleshooting Guide, Symptom, Group 2, in this section. If an alarm is actuated, observe the evaporator pressure gauge. If it reads normal (30 to 140 psi), the rupture disc may be faulty.

To resume operation after correction of the overpressure problem, replace the rupture disc. Purge any gas from the pressure relief system piping lines with dry air, nitrogen, or carbon dioxide as soon as possible after system actuation. Check the relief valve for leaks using 150 psi pressure. The valve must be leak-tight to function properly.



WARNING: TO PREVENT MAJOR RELEASE OF CHLORINE, CAUSING POSSIBLE SEVERE PERSONAL INJURY, DO NOT REMOVE THE PRESSURE RELIEF SYSTEM WHILE THE EVAPORATOR IS PRESSURIZED.

Before attempting to service the relief system, follow step a in paragraph 4.12, “In-Place” Cleaning Of Evaporator Cylinder. If, after this step, the pressure switch remains actuated, chlorine under pressure is still present in the pressure relief system. This indicates a leaking (not ruptured) rupture disc.



WARNING: TO AVOID SEVERE PERSONAL INJURY DUE TO INHALATION OF CHLORINE, USE AN APPROVED GAS MASK AND VENTILATION EQUIPMENT WHEN REMOVING THE RUPTURE DISC.

If the disc is removed and is not ruptured, a leaking disc is the trouble. In this case, a closed valve and/or blockage are not likely to be found. Replace the rupture disc.



CAUTION: When installing the rupture disc, ensure that the groove of disc fits the mating tongue of the safety head to avoid altering the operating level of the rupture disc.



WARNING: TO AVOID THE RUPTURE OF THE EVAPORATOR PRESSURE CYLINDER OR ITS CONNECTING PIPELINES, CAUSING POSSIBLE SEVERE PERSONAL INJURY AND EQUIPMENT DAMAGE, DO NOT ATTEMPT TO DISASSEMBLE OR REPAIR THE RELIEF VALVE. IF IT MALFUNCTIONS, REPLACE IT.



CAUTION: Purge the valve of gas as soon as possible after operation before moisture can combine with the gas to become corrosive.

4.11 Liquid Line Pressure Relief System

Overpressure in the liquid line is usually the result of a valve closed at the supply and at the evaporator at the same time. A contaminant blockage in the inlet line with a valve closed on either side can also cause an overpressure problem. The rupture disc will rupture at 400 psi, activating an alarm. If the system activates, as indicated by the alarm switch, the cause must immediately be determined and corrected. Usually, corrective action will involve opening one or more valves. To restore the liquid line pressure relief system, replace the rupture disc as instructed in the preceding section.



WARNING: TO AVOID MAJOR RELEASE OF CHLORINE, CAUSING POSSIBLE SEVERE PERSONAL INJURY, DO NOT OPEN THE LIQUID LINE PRESSURE RELIEF SYSTEM WHILE THE EVAPORATOR IS PRESSURIZED.

Before attempting to service the relief system, follow step a in paragraph 4.12, “In-Place” Cleaning Of Evaporator Cylinder.



CAUTION: Do not disturb the threaded joints between the alarm switch and the protective capsule. Any oil loss will result in a faulty pressure-gauge reading.

If this rupture disc is removed and is not ruptured, a leaking disc is the trouble. In this case, closed valves and/or blockage are not likely to be found. Replace leaking rupture disc. If the pressure switch remains actuated after performing step a in paragraph 4.12, “In-Place” Cleaning of the Evaporator Cylinder, chlorine is still under pressure in the pressure relief system. This indicates a leaking (not ruptured) rupture disc.



WARNING: TO AVOID SEVERE PERSONAL INJURY DUE TO INHALATION OF CHLORINE, USE AN APPROVED GAS MASK AND VENTILATION EQUIPMENT WHEN REMOVING THE RUPTURE DISC.



CAUTION: When installing rupture disc, ensure that the groove of the disc fits the mating tongue of safety head to avoid altering the operating level of the rupture disc.

Refer to 50.202.007.011. The expansion chamber is isolated from the chlorine by the rupture disc (10). Since the expansion chamber is not exposed to chlorine under normal conditions no preventative maintenance is required for the expansion chamber. The expansion chamber has a pressure switch (5) attached to it to monitor the chamber's internal pressure. The pressure switch (5) is preset to 20 psi at the factory. During initial start up this switch should be tested prior to installing the rupture disc (10) into the safety head union.

4.12 “In-Place” Cleaning of the Evaporator Cylinder

The rate of residue buildup varies considerably with the type of impurity, the source of chlorine supply, the rate of usage, and various other factors. The following maintenance cleaning procedure should be implemented every 12 months, or sooner if a loss in superheat or reduction in chlorine capacity is observed. These instructions describe a method for cleaning chlorine residue from the evaporator without removing the cylinder. The special accessories required by this procedure for cleaning and drying are available in kit form in Evoqua Water Technologies Part No. W3T109990. The replacement gaskets required for each evaporator are included in parts kit W3T110050. A water supply line of 3/4-inch pipe size at a minimum pressure of 20 psi must be available. The hose required is not furnished as part of either kit. If these instructions are carefully followed, the cylinder should be clean and dry when restored in service.

In some circumstances, it could be desirable to thoroughly review the relative advantages of cleaning versus simply replacing the evaporator cylinder, thereby eliminating the time and necessary complexities of the cleaning process and enjoying the security and full operating capacity provided by a new cylinder. This choice would take into consideration the local cost and availability of personnel, facilities, equipment, and time required for the cleaning process measured against the installed cost of a new cylinder. This comparison can be made only on the basis of individual local circumstances.

Under normal operating conditions, deposits will accumulate in the evaporator cylinder and, over a period of time, will reduce its operating capacity. For this reason, periodic cleaning is required to remove these deposits.



CAUTION: Refer to the instruction book provided with the equipment for complete details on recommended frequency and procedures to properly accomplish this cleaning.

To clean the evaporator cylinder “In-Place,” perform the following steps.



WARNING: ANY MOISTURE, INCLUDING ATMOSPHERIC, IS HIGHLY CORROSIVE WHEN COMBINED WITH CHLORINE. TO AVOID SEVERE PERSONAL INJURY AND EQUIPMENT DAMAGE AS A RESULT OF EXTREME CORROSION, THE CYLINDER MUST BE ABSOLUTELY DRY AFTER CLEANING IS COMPLETED.

a. With the evaporator controls on, evacuate the chlorine cylinder as follows:

- (1) Close the evaporator outlet valve. When the outlet valve is closed, gas will form inside the cylinder, thereby pushing liquid chlorine back to the supply container.



WARNING: IF THE SUPPLY CONTAINER DOES NOT HAVE ADEQUATE RESERVE CAPACITY TO ACCEPT THE MAXIMUM CONTENTS THAT ARE BEING FORCED FROM THE EVAPORATOR CYLINDER, DO NOT STOP THE CHLORINATOR. INSTEAD, IN ORDER TO PREVENT OVER-FILLING AND DEVELOPING EXTREME PRESSURES WITHIN THE SUPPLY CONTAINER, CLOSE THE SUPPLY VALVE AND USE THE CHLORINATOR OR GAS DISPOSAL SYSTEM TO COMPLETELY EVACUATE THE EVAPORATOR AND ITS CONNECTING PIPELINES.

- (2) If the maximum amount of contents can be forced out of the cylinder to the supply without exceeding the rated capacity of the supply container, the outlet valve can be closed. However, do not shut any valves in the chlorine supply piping.

NOTE: If the evaporator outlet is closed or chlorination is stopped, and if the inlet valve to the evaporator and the valves to the ton container or tank cars are open, the pressure within the evaporator cylinder will not exceed the pressure in the ton container or tank car.



WARNING: TO AVOID AN OVERPRESSURE CONDITION CAPABLE OF RUPTURING THE PIPING SYSTEM AND RESULTING IN A DISCHARGE OF GAS FROM THE GAS PRESSURE RELIEF SYSTEM, CAUSING POSSIBLE SEVERE PERSONAL INJURY AND EQUIPMENT DAMAGE, DO NOT CLOSE ANY SUPPLY VALVE WITHOUT FOLLOWING THE EVACUATION PROCEDURE FOR LONG-TERM SHUTDOWN IN PARAGRAPH 3.2.3B.

NOTE: Liquid chlorine has a high coefficient of thermal expansion.



WARNING: DO NOT CLOSE VALVES IN SUCH A WAY THAT LIQUID CHLORINE MAY BE TRAPPED, SINCE DANGEROUS PRESSURES CAPABLE OF RUPTURING THE PIPING SYSTEM MAY BUILD UP WITH A SMALL INCREASE IN TEMPERATURE.

- (3) Leave the evaporator outlet valve shut for approximately 30 minutes. Under these conditions, most of the liquid chlorine will be forced back to the supply tank through the inlet nipple and the remaining liquid will be evaporated by the heat of the water bath. At the end of this period, shut the valve at the tank car or the ton container, immediately open the evaporator chlorine outlet valve, and run the chlorinator to exhaust the gas in the evaporator and the gas and liquid in the inlet line. When the evaporator pressure gauge reads zero, the chlorine outlet valve may be closed. If the evaporator pressure gauge shows pressure after the outlet valve has been closed for several minutes, repeat the above procedure until the evaporator pressure gauge reads zero with outlet valve closed. Then turn off power to the control system and alarm units. If no standby evaporator is being used, shut down the chlorinator. Remove the enclosure and the associated hardware.
- b. Drain water from the water tank by opening drain valve (17). See drawing 50.200.060.010.
- c. Remove cap plug (57) from top of water tank.
- d. Through the port hole located on top of the hot water tank, examine the visible exterior of the chlorine cylinder with a flashlight. Inspect the surface. If signs of pitting or corrosion are evident, proceed to paragraph 4.13, Five-Year Inspection.



WARNING: TO AVOID SEVERE PERSONAL INJURY DUE TO INHALATION OF CHLORINE, USE AN APPROVED GAS MASK AND BE PREPARED TO RECONNECT UNION QUICKLY IF THERE IS ANY SIGN OF PRESSURE IN THE GAUGE LINE.



CAUTION: Do not disturb the threaded joint between the pressure gauge and the protecting oil-filled capsule. Any loss of oil will result in a faulty indication by the pressure gauge.

- e. Remove the temperature gauge (97) bulb from the well in the cylinder flange (30). Put on an approved-type gas mask before proceeding. Disconnect the pressure gauge (87) and the chlorine inlet and outlet piping through the unions (19) on the top of the cylinder.
- f. Remove the upper cylinder flange cover plate from the cylinder (30) and attached parts. Note the orientation of the chlorine inlet and outlet pipes.



CAUTION: Do not lose or misplace any of the nuts or brackets when disassembling the upper flange.

- g. Examine the interior of the cylinder. Because residues vary widely, it is not possible to describe exactly what may be found. However, it may be expected that the upper portion of the cylinder will be lined with a reddish-

brown ferric chloride and the lower portion will contain a mixture of ferric chloride and other residue. This mixture may be solid, liquid, or of some intermediate consistency.

- h. Disconnect the ammonia union (19) at the bottom chlorine inlet (47).
- i. Using the flange W2T18194 with nipple W2T16303, from the W3T109990 drying kit, run a one-inch hose line from the bottom chlorine inlet connection to a drain, as shown in Dwg. 50.200.150.010.
- j. Loosen any residual buildup from the internal walls of the cylinder.
- k. Remove riser pipe W2T19060 from the bottom chlorine inlet and flush the cylinder with water at a minimum of flow of 5 GPM. Continue to flush until the discharge water is clean.
- l. Inspect the interior surface for pitting and corrosion. If pitting exceeds 0.125-inch deep, if deep seated corrosion is apparent, or if cylinder seems to be of questionable condition, either proceed with the five-year inspection procedure (paragraph 4.13) or replace the cylinder and the appropriate components.
- m. Thoroughly dry all internal surfaces and items within the cylinder, as any residual moisture will accelerate corrosion once combined with chlorine.



WARNING: ANY MOISTURE, INCLUDING ATMOSPHERIC, IS HIGHLY CORROSIVE WHEN COMBINED WITH CHLORINE. TO AVOID SEVERE PERSONAL INJURY AND EQUIPMENT DAMAGE FROM EXTREME CORROSION, AND POSSIBLE FAILURE OF THE CYLINDER, IT MUST BE ABSOLUTELY DRY AFTER CLEANING IS COMPLETED.

- n. Unbolt (23) and remove the bottom chlorine inlet pipe and flange (47). Remove as much water as possible from the bottom of the cylinder with a rag or sponge to reduce drying time. Dry the bottom chlorine inlet pipe (47) thoroughly by baking or other means.
- o. After the cylinder and other parts have been dried thoroughly, replace the riser pipe and the cylinder flange cover plate using a new gasket W2T18796. Tighten the bolts uniformly to 270 ft lb.

NOTE: When replacing the cylinder flange cover plate, it is necessary to observe the orientation of the inlet and outlet as stamped on the top of the flange and install accordingly.



WARNING: IF USER OUTLET PIPING IS CONNECTED TO THE EVAPORATOR INLET PIPE, LIQUID CHLORINE WILL DISCHARGE FROM THE EVAPORATOR, CAUSING EQUIPMENT DAMAGE AND POSSIBLE SEVERE PERSONAL INJURY. THEREFORE, ENSURE THAT USER PIPING IS CONNECTED TO THE EVAPORATOR OUTLET PIPE.

- p. Replace the bottom chlorine inlet pipe (47) using a new gasket W2T16384. Connect the injector, W3T107574 from the W3T109990 drying kit, to the bottom chlorine inlet per Dwg. 50.200.150.010. Install vacuum gauge W2T19897 into the top flange of the cylinder (30).
- q. Turn on the evaporator controls and raise the temperature in the tank to 180°F. Pull a vacuum via the injector and maintain for 1/2 hour at a minimum of 22 inches of mercury.
- r. Shut off the vacuum line and observe the vacuum gauge. If a vacuum of 22 inches of mercury or more can be held for one minute, and all parts of the system being dried are heated by the 180°F water bath, no further evacuation is necessary. If not, continue to pull a vacuum until 22 inches of mercury can be held for 1/2 hour.
- s. Disconnect the injector and restore the bottom chlorine inlet piping (47). Use a new gasket W2T16384 in the ammonia-type union on the inlet piping (47).
- t. Remove the vacuum gauge and reconnect the chlorine pressure gauge in the top flange using a new O-ring W2T11775.
- u. Refer to paragraph 4.14, Operational Inspection of the Pressure Relief Systems, to test both the gas pressure relief system and the liquid line pressure relief system.
- v. Refer to paragraph 3.1, Preparation For Initial Operation, to put the evaporator back into service.
- w. Replace the enclosure and put the evaporator into service.

4.13 Five-Year Inspection of Evaporator Cylinder

This inspection is conducted either every five years, after 12 “in-place” cleanings, or when indicated by step d or l, paragraph 4.12.

NOTE: Canadian owners of evaporators must comply with local regulations governing periodic inspection and testing of the pressure vessel.

- a. Complete steps “a” through “l” of the “In-Place” Cleaning of the Evaporator Cylinder Procedure (paragraph 4.12).
- b. Remove the silicone bead surrounding the top of the cylinder (30) and the hot water tank (29).
- c. Install the top flange and lifting brackets back into the evaporator cylinder. Bolt the brackets securely in place, making sure the brackets are 180 degrees apart.

- d. Disconnect the ammonia union (19) at the bottom chlorine inlet (47).
- e. Unbolt (23) and remove the chlorine inlet (47) from the bottom of the cylinder (30).
- f. Disconnect the four cylinder mounting bolts (26) beneath the evaporator water tank (29). Remove the cylinder (30) from the hot water tank (29), using the two lifting brackets (see Dwg. 50.200.150.010).
- g. Remove the external scale, etc. Verify that the inside of the cylinder is free of residue.
- h. Weigh the cylinder. (Exclude the internal riser, top flange, brackets, bolts, nuts, gaskets, and down-drop pipes.)
- i. If the present weight is 10 or more pounds less than the original tare weight (stamped on the cylinder), scrap the cylinder and replace it with a new one.

NOTE: Exterior corrosion indicates improper maintenance of the cathodic protection system. Interior corrosion usually indicates the presence of moisture in the cylinder.

- j. Clean, inspect, and replace, as necessary, the hot water tank, temperature switch sensing bulb, overflow outlet, and cathodic protection anodes. If there is any doubt about any component, replace it.
- k. Replace the new or re-tested cylinder (30) into the hot water tank (29) with a new bottom gasket (28, Dwg. 50.200.060.010). Install four bolts (26).
- l. Reassemble per steps (n, h, and e) "In-Place" Cleaning of Evaporator Cylinder Procedure (paragraph 4.12).

4.14 Operational Inspection of the Pressure Relief Systems

Perform an operational inspection of the pressure relief system before completely re-assembling the evaporator exterior piping. Make the following checks on the pressure relief systems during "in-place" cleaning at the five-year inspection of the chlorine cylinder.



WARNING: TO AVOID THE RELEASE OF CHLORINE INTO THE ATMOSPHERE, DO NOT REMOVE EITHER PRESSURE RELIEF SYSTEM WHILE THE EVAPORATOR IS PRESSURIZED. BEFORE ATTEMPTING TO SERVICE THE PRESSURE RELIEF SYSTEM, FOLLOW STEP A IN PARAGRAPH 4.12.

4.14.1 Evaporator Gas Pressure Relief System

- a. Carefully remove the rupture disc. Do not damage the surfaces or the remove tape that secures the components together. Check the system components for signs of internal or external corrosion. Replace as necessary.
- b. Reassemble safety head (union) without the rupture disc.
- c. Pressurize the system at rupture disc connection to 50 psi with dry air, carbon dioxide, or nitrogen. Alarm should activate immediately and pressure should hold. Check for leaks.
- d. Reinstall the rupture disc and pressurize to 150 psi. Pressure should hold. If an alarm sounds or pressure does not hold, replace the disc and retest at 150 psi.

4.14.2 Liquid Line Pressure Relief System

- a. Loosen the union nut on the union safety head. This will separate the union halves and allow you to lift off the expansion chamber (11) and pressure switch (5) as an assembly. This will also give you access to the rupture disc (10). Refer to Dwg. 50.202.007.011.
- b. Carefully remove rupture disc. If any internal or external corrosion is noted, the expansion chamber must be hydrostatically tested at 840 psig (and cleaned and dried) or replaced. Replace other components as necessary.
- c. Reassemble the safety head (union) without the rupture disc.
- d. Pressurize the system to 50 psi with dry air, carbon dioxide, or nitrogen. An alarm should activate immediately and the pressure should hold. Check for leaks.
- e. Reinstall the rupture disc and pressurize to 150 psi. Pressure should hold. If an alarm sounds or pressure does not hold, replace the disc and retest at 150 psi.

4.14.3 Pressure Alarm Switch

If an alarm does not activate during the relief system test, perform the checks detailed in paragraph 4.4, Relief System Pressure Switches, to determine whether the switch requires adjustment or replacement.

4.15 Troubleshooting Guide

NOTE: All symptoms in any given group occur concurrently unless otherwise noted.

Table 4.1 - Troubleshooting

Symptom	Probable Cause	Corrective Action
Group 1 Liquid Chlorine in Chlorinator Rotameter. Chlorinator Plastic Material Deterioration. Chlorinator Erratic.	<p>Liquid chlorine discharged from evaporator outlet as a result of any of the following conditions:</p> <p>(a) Demand on evaporator exceeds design capacity.</p> <p>(b) Supply pressure too high (see Probable Cause in Group 2).</p> <p>-OR-</p> <p>Inadequate heat transfer as a result of contaminant build-up on inside of cylinder and/or deposit build-up on outside of cylinder.</p> <p>-OR-</p> <p>Low water bath temperature with low temperature switch failing to close GPRV* (or VR-CU), sound alarm, and activate panel light. (See Probable Cause in Group 5.)</p> <p>(c) By-pass open around GPRV* (if provided)</p> <p>(d) GPRV* (if provided) leaking pressure across valve.</p>	<p>(a) Reduce chlorinator gas withdrawal rate.</p> <p>(b) Reduce cylinder pressure. See Corrective Action for High Pressure in Group 2.</p> <p>Close supply valve, evacuate system, and shut down. See Long-Term Shutdown in Section 3. Clean cylinder interior and exterior. See "In-Place" Cleaning of Evaporator Cylinder in Section 4.</p> <p>See Corrective Action for Symptom Group 5.</p> <p>(c) Close by-pass</p> <p>(d) Close supply valve, evacuate system and shut down. See Long-Term Shutdown in Section 3. See GPRV* instruction book for valve repair.</p>

*GPRV - Gas Pressure Reducing Valve; VR-CU - Vacuum Regulator-Check Unit

Table 4.1 - Troubleshooting (Cont'd)

Symptom	Probable Cause	Corrective Action
<u>Group 2</u> High Pressure Reading Front Panel Gauge (Above 140 PSI). (If Pressure Reaches 400 PSI, Rupture Disc Will Burst and Relief System Pressure Alarm Will Be Activated.)	<p>High pressure inside evaporator cylinder due to any of the following:</p> <p>(a) Air padded supply pressure too high.</p> <p>(b) Valve closed between evaporator inlet and supply with evaporator outlet closed or chlorination stopped.</p> <p>(c) Blockage in supply line due to contaminants with evaporator outlet closed or chlorination stopped.</p>	<p>(a) Reduce air padding pressure.</p> <p>(b) Open all valves in supply line.</p> <p>(c) Open valves, as required, to avoid trapping liquid in supply line, evacuate system and shut down. Follow Long-Term Shut-down in Section 3. Clean supply line.</p>
<u>Group 3</u> Supply Line Pressure Gauge (Where Provided) is Pinned at Maximum Reading. Supply Line Pressure Relief System Alarm** (Where Provided) Activated When Rupture Disc Bursts (at 400 PSI). Chlorine May Leak From Fittings as Pressure Increases.	<p>Excessive pressure in supply line due to any of the following conditions:</p> <p>(a) Liquid trapped between two closed valves.</p> <p>(b) Liquid trapped in evaporator cylinder by closing valve at supply and stopping chlorination.</p> <p>(c) Liquid trapped between a closed valve and a blockage in the line.</p>	<p>(a) Open all valves in supply line.</p> <p>(b) Evacuate system and shut down. Replace rupture disc.</p> <p>(c) Open valve, evacuate system and shut down. Follow Long-term Shutdown in Section 3. Clean lines.</p>

**Alarms will not activate if customer power fails.

Table 4.1 - Troubleshooting (Cont'd)

Symptom	Probable Cause	Corrective Action
<u>Group 4</u> Evaporator Pressure Relief System Pressure Alarm** Activates but Front Panel Pressure Gauge Reads Between 30 and 140 PSI. -OR- Liquid Line Pressure Relief System Alarm** Activates but Liquid Line Pressure Gauge Reads Between 30 and 140 PSI.	Rupture disc leaks.	Following Long-Term Shutdown processdure in Section 3. Replace disc.

**Alarms will not activate if customer power fails.

Table 4.1 - Troubleshooting (Cont'd)

Symptom	Probable Cause	Corrective Action
Group 5 Low Temperature Panel Light On. Low Temperature Alarm** (If Provided) Activates. Low Reading (Below 160°F) On Panel Temperature Meter. GPRV* (Or VR-CU) Closed. Possible Additional Symptom: Low Water Level Alarm** (If Provided) and Low Water Level Panel Light On; See (h) Next Column.	<p>Low tank water temperature as a result of any of the following conditions:</p> <p>(a) Gas demand exceeds evaporating capacity.</p> <p>(b) Circulator pump stops or rotates in wrong direction.</p> <p>(c) Solenoid valve stuck open admitting cold water into tank. (Water will be flowing out of over-flow connection.)</p> <p>(d) Water leaking out of tank or piping.</p> <p>(e) Heater contactor failure: coil or contacts worn out.</p> <p>(f) Heat exchanger malfunction: 1, 2 or all 3 elements burn out or heater is not of the proper voltage or power rating.</p> <p>(g) Temperature control circuitry on circuit board or temperature sensor in probe housing fails or is incorrectly wired.</p> <p>(h) Low water level condition, see Probable Cause in Group 8.</p> <p>NOTE: A false alarm condition would exist if the low temperature alarm switch is not set to 160°F or a temperature alarm switch fails.</p>	<p>(a) Reduce gas withdrawal rate.</p> <p>(b) Check pump motor and wiring. Correct wiring or replace faulty equipment.</p> <p>(c) Check solenoid valve for foreign matter jamming valve. Check water level probe wiring and control circuit. Replace equipment, if faulty.</p> <p>(d) Correct leaks.</p> <p>(e) Check coil and contacts. Replace faulty equipment.</p> <p>(f) Check elements and nameplate ratings. Replace faulty equipment.</p> <p>(g) Check wiring or replace faulty equipment.</p> <p>(h) See Corrective Action for System, Group 8.</p> <p>Replace temperature switch assembly.</p>

*GPRV - Gas Pressure Reducing Valve; VR-CU - Vacuum Regulator-Check Unit

**Alarms will not activate if customer power fails.

Table 4.1 - Troubleshooting (Cont'd)

Symptom	Probable Cause	Corrective Action
<u>Group 6</u> High Temperature Panel Light On. High Temperature Alarm** (If Provided) Activates. Heat Exchanger Off. (Alarm and Panel Light May Switch On and Off Periodically Due to the Cooling and Reheating of the Water About the Switch Setpoint.)	High tank water temperature as a result of: (a) Temperature control on circuit board fails or is incorrectly wired. (b) Temperature control sensor in probe housing fails or is incorrectly wired. NOTE: A false alarm condition would exist if the high temperature alarm switch is not set to 200°F or a temperature alarm switch fails.	(a) Replace faulty equipment or correct wiring. (b) Replace faulty equipment or correct wiring. Replace temperature switch assembly.
<u>Group 7</u> Low Water Level Panel Light On. Low Water Level Alarm** (If Provided) Activates. Heat Exchanger and Circulator Off. GPRV* (Or VR-CU) Closed. Water Level in Sight Glass Low or Not Visible at All. Possible Additional Symptom: Low Water Temperature Alarm** (If Provided) and Panel Light Activate.	Low water level condition as a result of any of the following: (a) Water supply blocked or failed. (b) Solenoid valve clogged or faulty. (c) Leak(s) in tank or piping. (d) Drain valve is open or leaking. (e) Control for automatic water re-fill fails or water level probes are incorrectly wired.	(a) Clean out piping. Restore supply. (b) Clean or replace faulty valve. (c) Correct leak(s). (d) Close or replace valve. (e) Replace faulty controls or check wiring.

*GPRV - Gas Pressure Reducing Valve; VR-CU - Vacuum Regulator-Check Unit

**Alarms will not activate if customer power fails.

Table 4.1 - Troubleshooting (Cont'd)

Symptom	Probable Cause	Corrective Action
<u>Group 8</u> Water Coming Out of Overflow Connection and/or Spilling Over Tank Top Onto Floor. Sight Glass in Water Level Indicator is Full or Nearly Full. Possible Additional Symptom: Low Water Temperature Alarm** (If Provided) and Panel Light Activate.	High water level as a result of any of the following conditions: (a) Foreign material jamming solenoid valve open. (b) Faulty solenoid valve. (c) Automatic water refill circuit failure or incorrect level probe wiring.	(a) Clean solenoid valve. (b) Replace valve. (c) Replace faulty controls or check wiring.

**Alarms will not activate if customer power fails.

WARNING LABELS AND TAGS

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

W2T15483: 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.

W2T13513: DO NOT REMOVE THIS TAG. FACTORY ASSEMBLED UNITS INCLUDE EITHER A PRESSURE RELIEF DEVICE OR EXPANSION CHAMBER TO SATISFY THE REQUIREMENTS OF ASME CODE, CHLORINE INSTITUTE AND/OR RECOMMENDED PRACTICES OF THE COMPRESSED GAS ASSOCIATION. TO MAINTAIN PROPER OPERATION OF THESE ASSEMBLIES IT IS ESSENTIAL THAT THE FOLLOWING PRECAUTIONS BE OBSERVED.

- A. Do not disassemble the protective diaphragm (3) from pressure switch (4).
- B. The rupture disc (5) is pressure rated for its particular service. Should replacement be necessary, an identical unit must be ordered & installed.
- C. See the Evoqua Water Technologies instruction book furnished for parts ordering information and for further detailed operating instructions.

W2T15394: TO AVOID POSSIBLE SEVERE PERSONAL INJURY FROM ELECTRICAL SHOCK TURN POWER OFF BEFORE SERVICING.

L2257: TO AVOID POSSIBLE PERSONAL INJURY FROM ELECTRICAL SHOCK, TURN POWER OFF BEFORE SERVICING.

WARNING LABELS AND TAGS (CONT'D)

W2T12672: LINE VOLTAGE PRESENT AT THIS LOCATION EVEN WHEN THE PANEL POWER SWITCH IS IN THE OFF POSITION. TO AVOID POSSIBLE SEVERE PERSONAL INJURY DUE TO ELECTRICAL SHOCK, DISCONNECT EXTERNAL POWER SUPPLY BEFORE SERVICING.

W2T13501: TO AVOID POSSIBLE SEVERE PERSONAL INJURY DUE TO HIGH TEMPERATURE CAUSING BURNS, DISCONNECT POWER AND ALLOW TO COOL BEFORE HANDLING.

W2T13515: 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.

WARNING LABELS AND TAGS (CONT'D)

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.
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.
11. Liquid chlorine has a high temperature coefficient of expansion. Do not close valves in such a way that liquid chlorine may be trapped since dangerous pressures capable of rupturing the piping system may build up with a small increase in temperature.

To avoid possible severe personal injury from electrical shock, turn power off before servicing this equipment.

DO NOT REMOVE THIS SIGN FROM THIS EQUIPMENT

50-200 EVAPORATOR FOR CHLORINE

CAUTION LABELS AND TAGS

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

W2T11771: FOR CHLORINE USE ONLY.

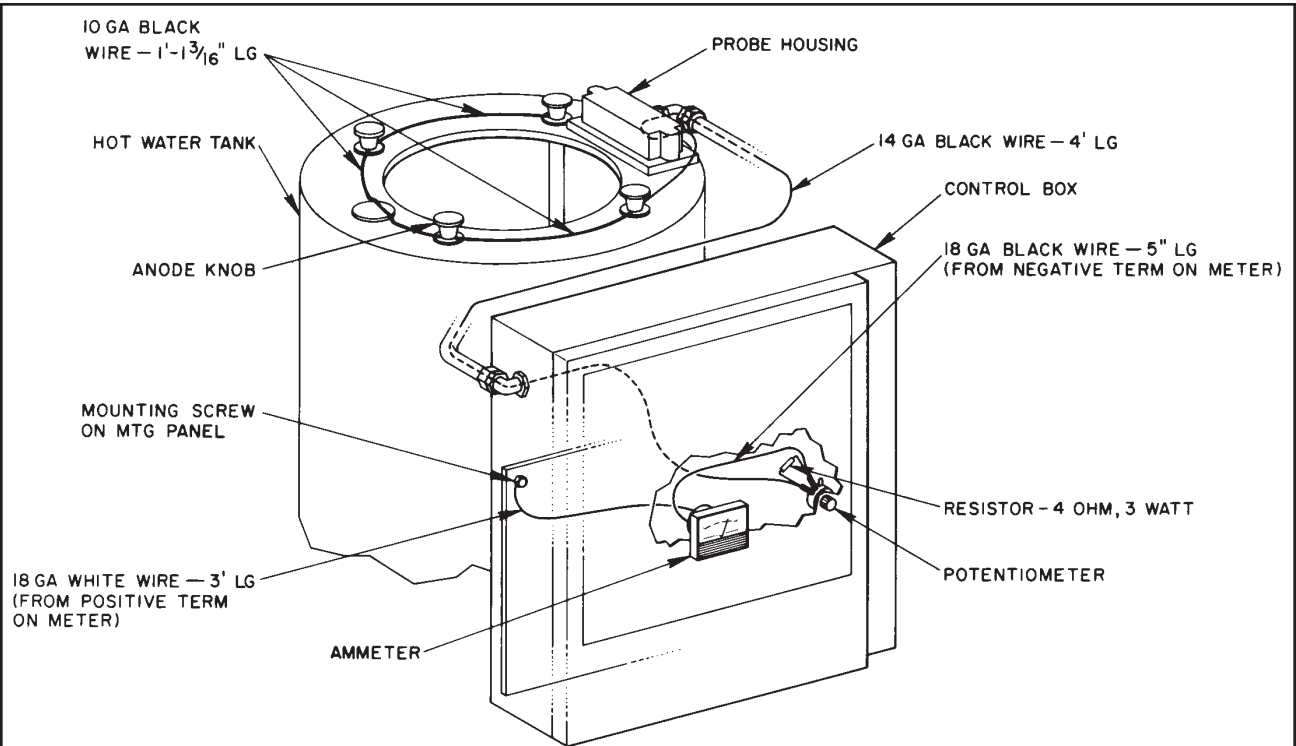
W2T13514: UNDER NORMAL OPERATING CONDITIONS DEPOSITS WILL ACCUMULATE IN THE EVAPORATOR CYLINDER AND OVER A PERIOD OF TIME WILL REDUCE ITS OPERATING CAPACITY. FOR THIS REASON PERIODIC CLEANING IS REQUIRED TO REMOVE THESE DEPOSITS. THE INSTRUCTION BOOK PROVIDED WITH THIS EQUIPMENT PROVIDES COMPLETE DETAILS ON RECOMMENDED FREQUENCY AND PROCEDURES TO PROPERLY ACCOMPLISH THIS CLEANING AND MUST BE REFERRED TO FOR THAT GUIDANCE.

L2135: DO NOT DISCONNECT THIS SEAL ASSEMBLY FROM GAUGE. SEAL PROOF PRESSURE 840 P.S.I.

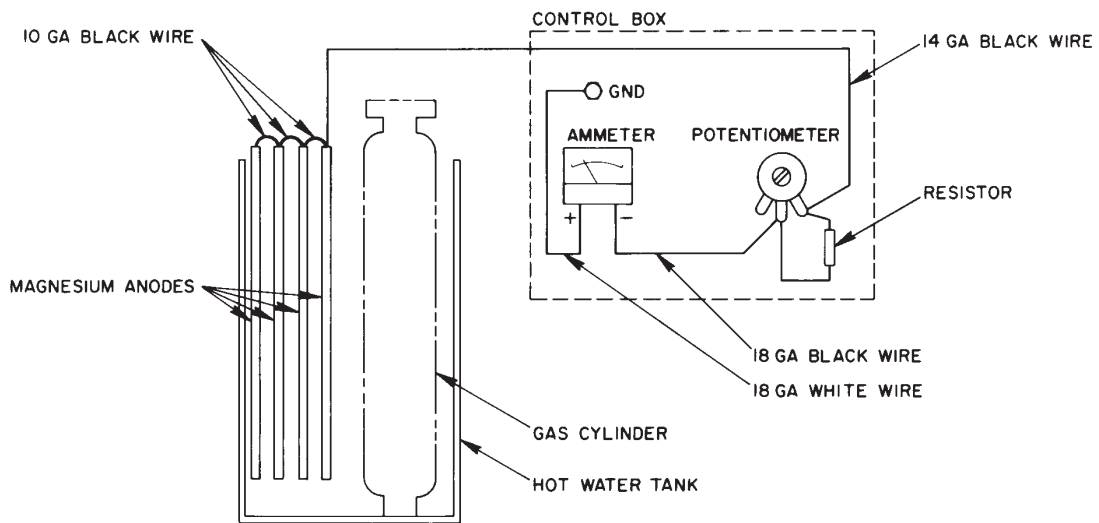
L2137: DO NOT DISCONNECT THIS SEAL ASSEMBLY FROM PRESSURE SWITCH. SEAL PROOF PRESSURE 840 P.S.I.

L3222: TO PREVENT DAMAGE TO EQUIPMENT, ALWAYS REPLACE COVER AFTER SERVICING.

50-200 EVAPORATOR FOR CHLORINE



ANODE WIRING



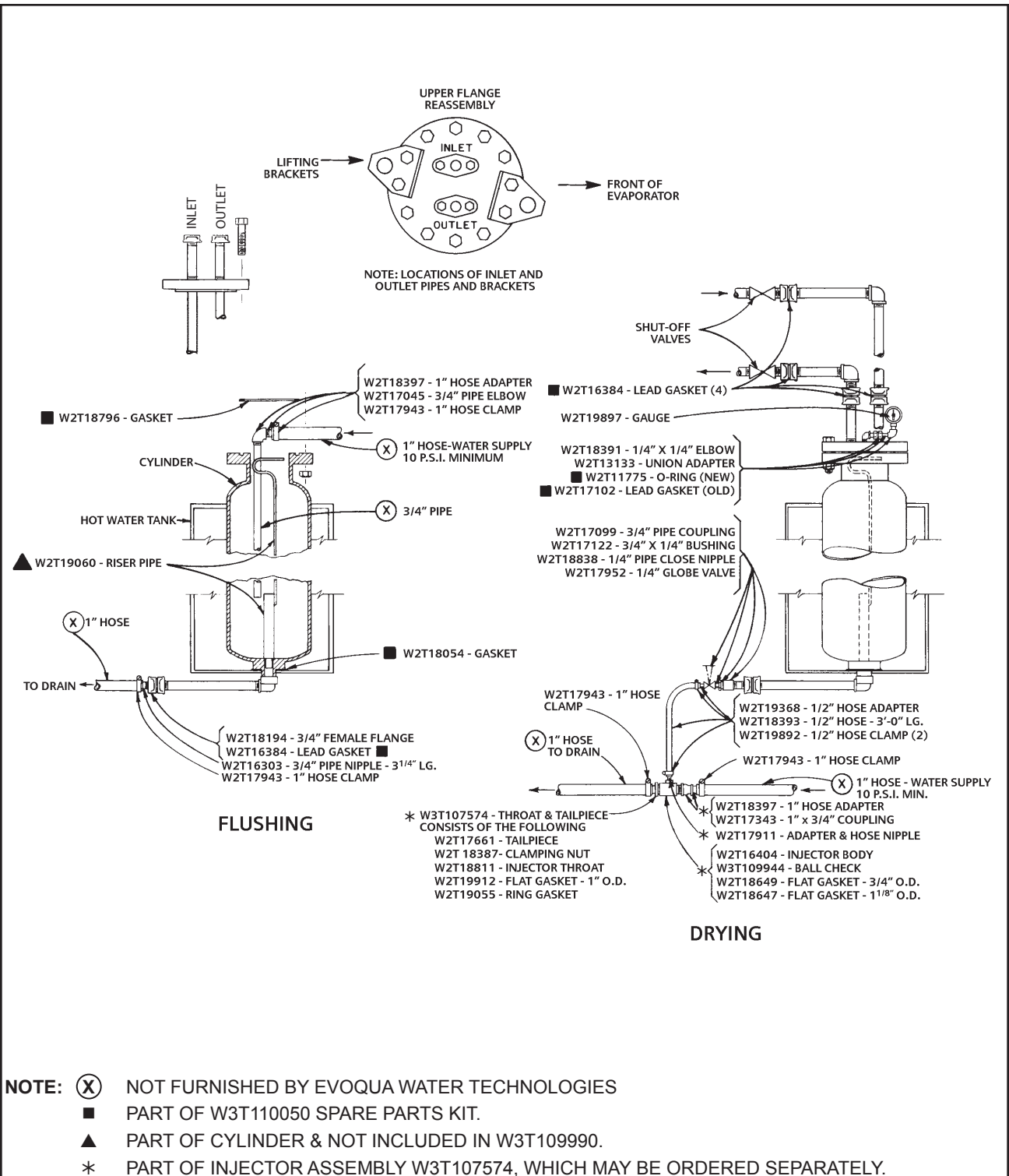
CIRCUIT DIAGRAM

SERIES 50-200 EVAPORATOR - WIRING
Cathodic Protection

50.200.140.010

ISSUE 1 1-90

50-200 EVAPORATOR FOR CHLORINE

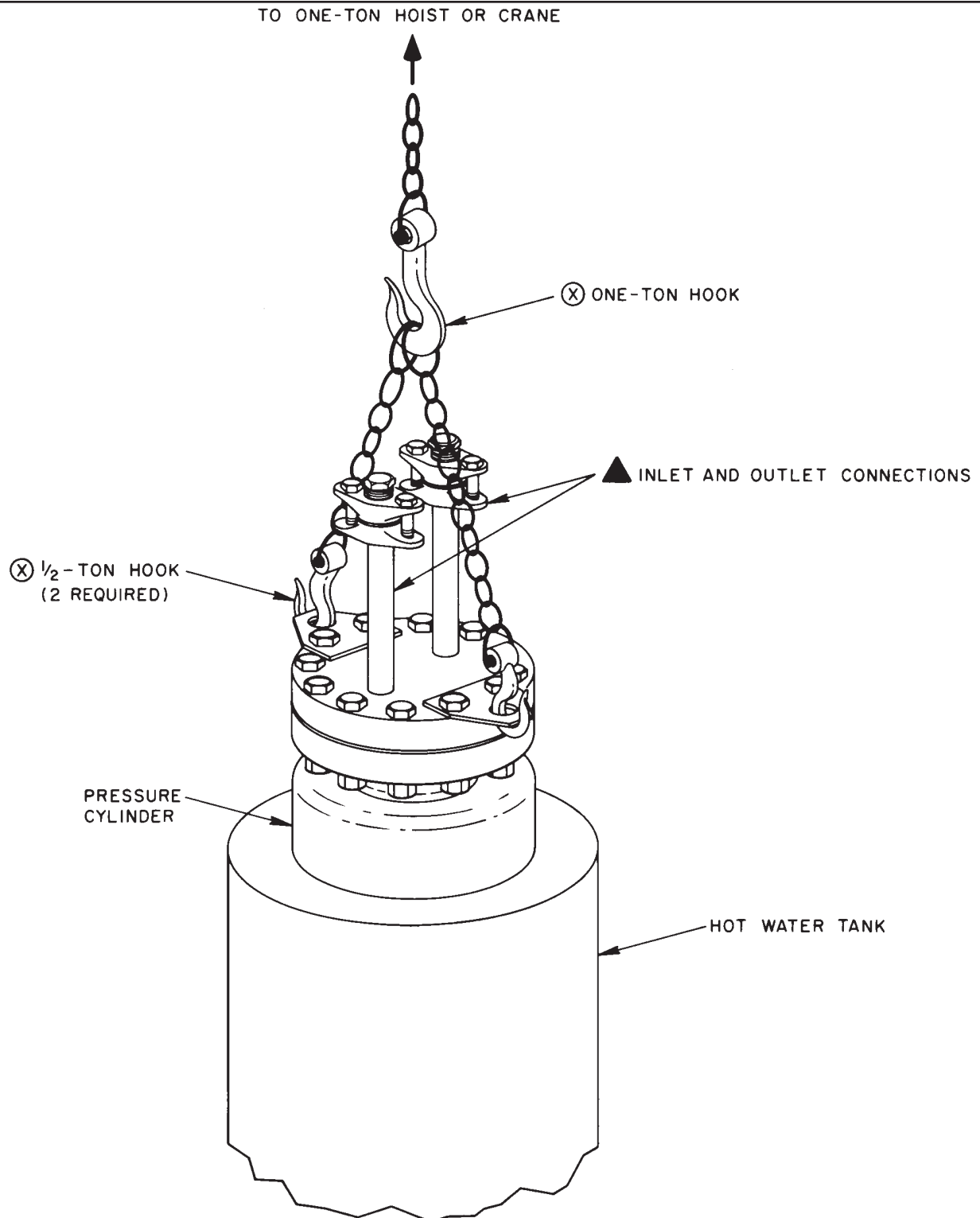


W3T109990 DRYING KIT FOR SERIES 50-200 EVAPORATOR - SERVICE

50.200.150.010

ISSUE 3 8-14

50-200 EVAPORATOR FOR CHLORINE



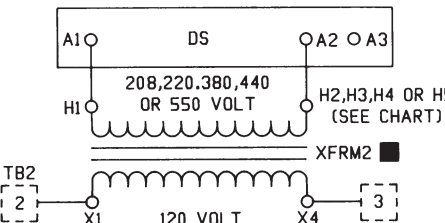
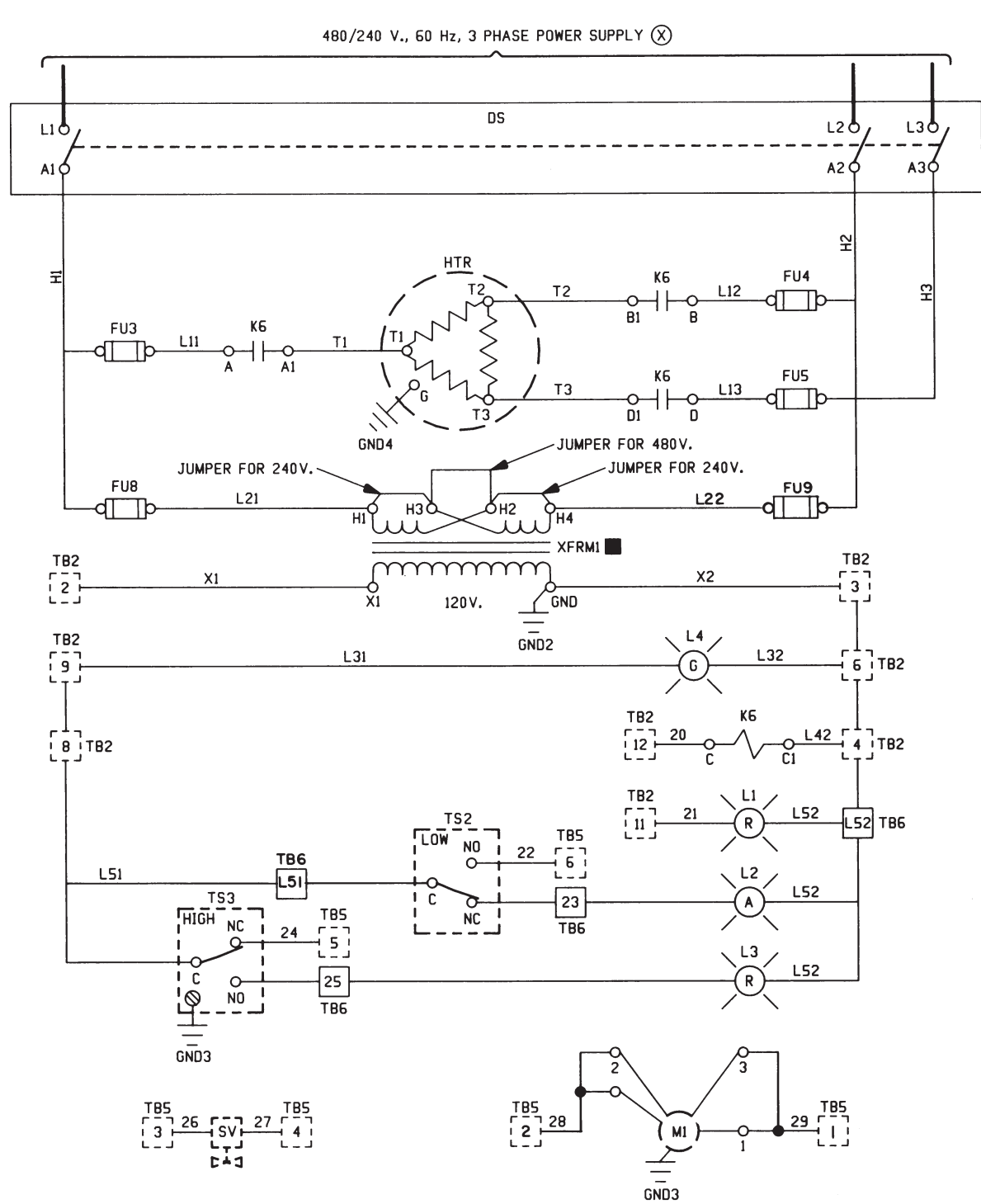
WARNING: ▲ TO AVOID POSSIBLE SEVERE PERSONAL INJURY AND EQUIPMENT DAMAGE, DO NOT ATTEMPT TO LIFT EVAPORATOR BY INLET AND OUTLET CONNECTIONS.

NOTE: (X) NOT FURNISHED BY EVOQUA WATER TECHNOLOGIES

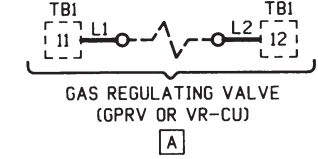
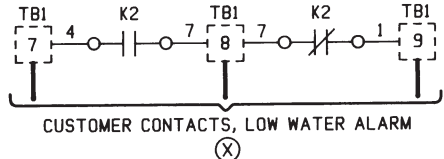
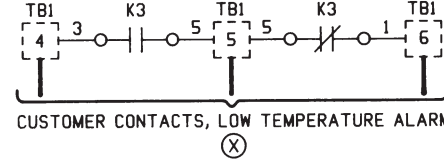
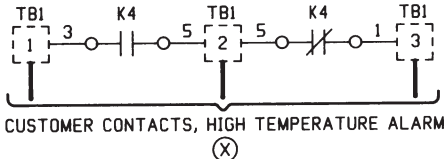
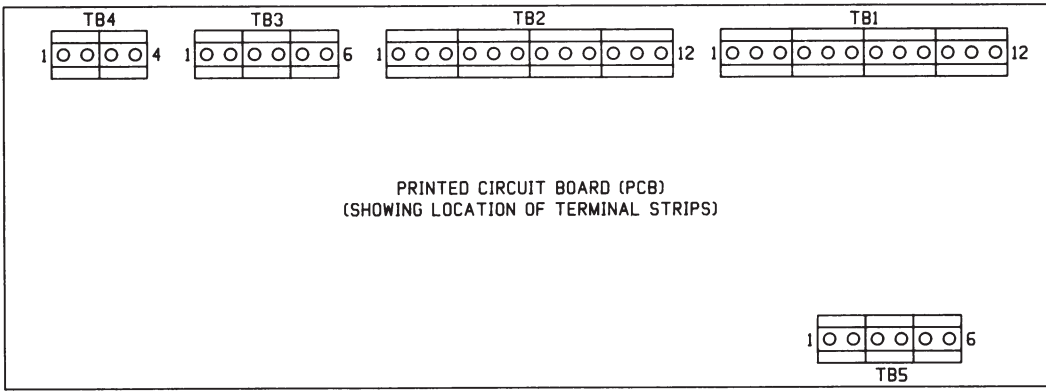
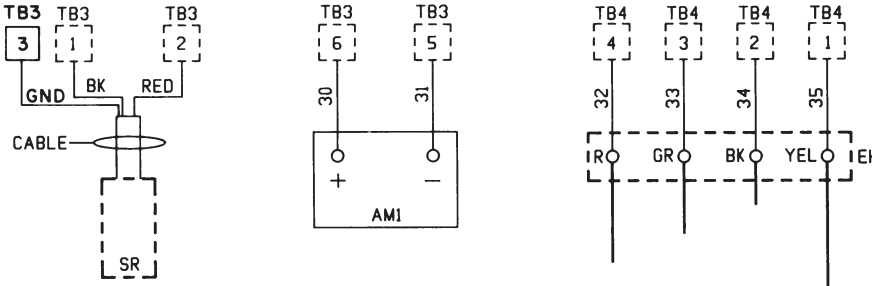
LIFTING METHOD - SERVICE

50.200.150.060

ISSUE 3 8-14



VOLTAGE:	CONNECT A2 TO:
208	H2
220	H2
380	H3
440	H4
550	H5



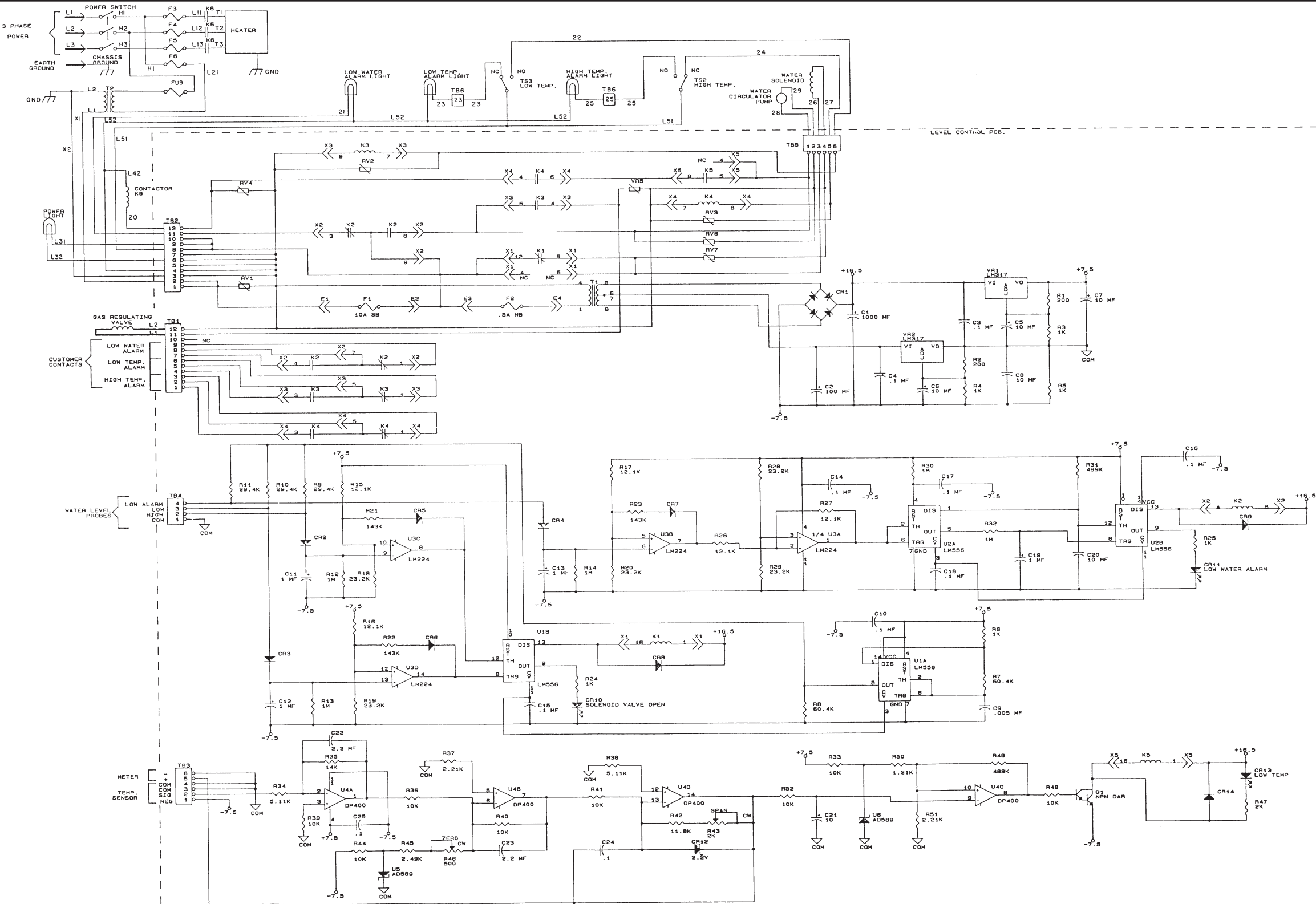
LEGEND

- AM1 --- TEMPMEETER
- DS --- DISCONNECT SWITCH
- EH --- PROBE HOUSING
- FU3 --- FUSE, 30 AMP, 45 AMP OR 60 AMP
- FU4 --- FUSE, 30 AMP, 45 AMP OR 60 AMP
- FU5 --- FUSE, 30 AMP, 45 AMP OR 60 AMP
- FU8, FU9 --- FUSE, 3.0 AMP, 3.5 AMP OR 7.0 AMP
- GND1 --- GROUND CONNECTOR
- GPRV --- GAS PRESSURE REGULATING VALVE OR VR-CU --- VACUUM REGULATING CHECK UNIT
- HTR --- HEAT EXCHANGER
- K6 --- HEAT EXCHANGER CONTACTOR
- L1 --- LOW WATER LEVEL LIGHT
- L2 --- LOW TEMPERATURE LIGHT
- L3 --- HIGH TEMPERATURE LIGHT
- L4 --- POWER LIGHT
- M1 --- PUMP MOTOR
- PCB --- CONTROL PRINTED CIRCUIT BOARD
- SR --- TEMPERATURE SENSOR
- SV --- SOLENOID VALVE
- TS2 --- HIGH TEMPERATURE SWITCH
- TS3 --- LOW TEMPERATURE SWITCH
- XFRM1 --- 240/480 VOLTAGE TRANSFORMER OR XFRM2 --- UNIVERSAL VOLTAGE TRANSFORMER
- Terminal Strip in Control Panel
- Terminal Strip on Printed Circuit Board (PCB)

NOTE: --- COMPONENTS REMOTE FROM PANEL.
■ XFRM1 OR XFRM2 AS SPECIFIED IN QUOTATION.
--- WIRING BY EVOQUA WATER TECHNOLOGIES
(X) NOT FURNISHED BY EVOQUA WATER TECHNOLOGIES
--- FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.
[A] ACCESSORY ITEM FURNISHED ONLY IF SPECIFIED IN QUOTATION.

SERIES 50-200 EVAPORATOR - SCHEMATIC WIRING Controls and Equipment

50.200.155.010
ISSUE 6 8-14



NOTE: — WIRING BY EVOQUA WATER TECHNOLOGIES
 — FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

LEVEL AND TEMPERATURE CONTROL
 - SCHEMATIC WIRING
 50.200.155.020
 ISSUE 5 8-14

50-200 EVAPORATOR FOR CHLORINE

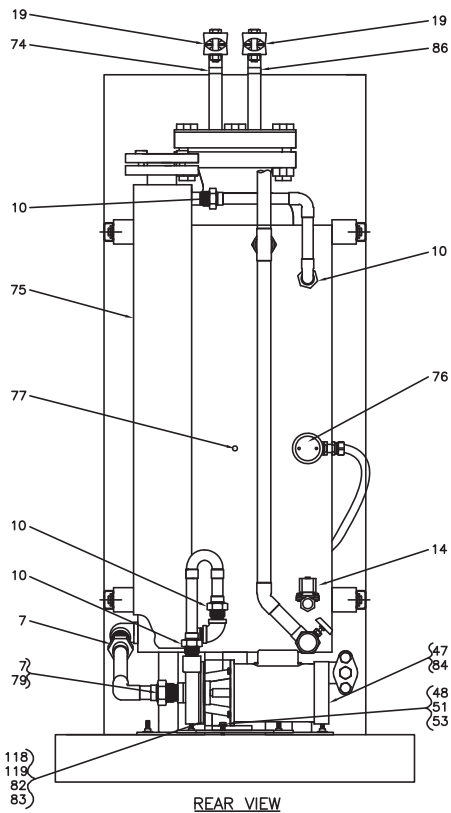
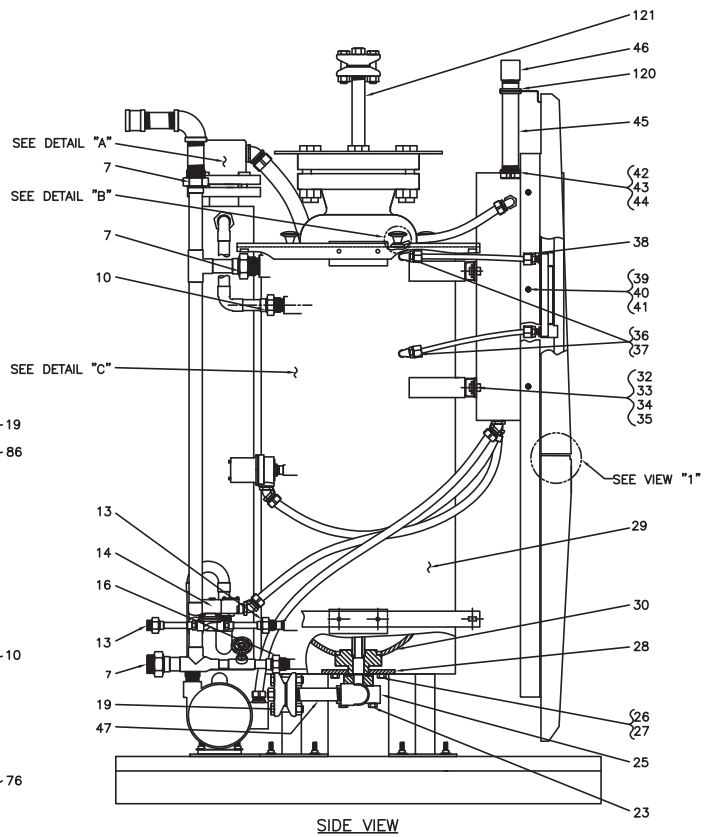
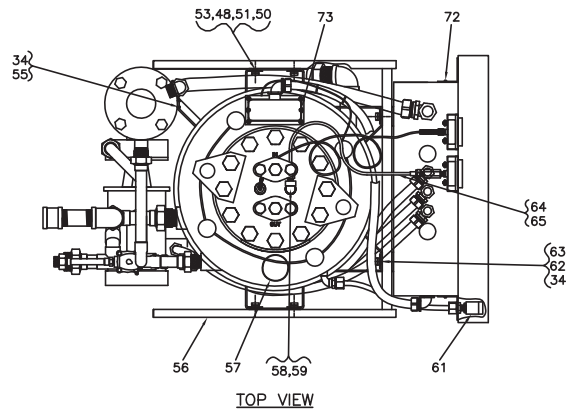
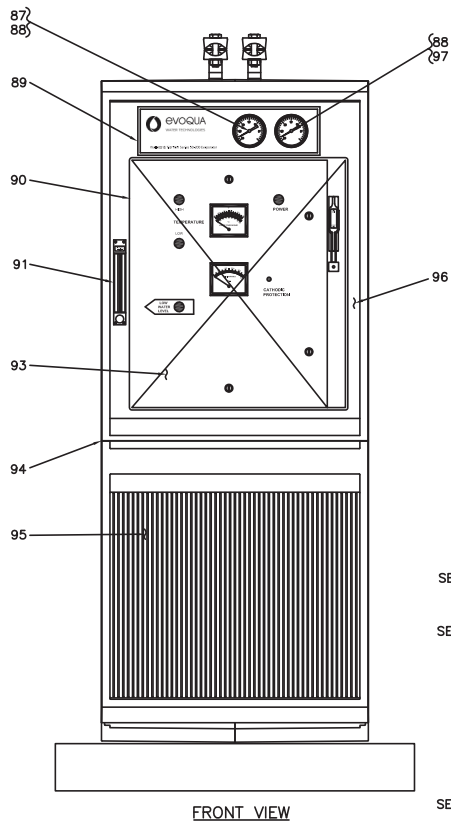
SECTION 5

SECTION 5 - ILLUSTRATIONS

List Of Contents

	DRAWING NO.
Parts	
Evaporator - Basic Components	50.200.060.010A-F
Water Level and Temperature Control Probes	50.200.000.020A&B
W2T365042 Controls Enclosure	50.200.060.020A-C
W3T108117 Enclosure	50.200.060.030A&B
W3T99062 Liquid Line Pressure Relief System	50.202.007.011
W3T97782 Gas Pressure Relief System	50.202.008.011
Series 510-050 Flowmeter	50.200.000.040A&B

50-200 EVAPORATOR FOR CHLORINE



SERIES 50-200 EVAPORATOR - PARTS

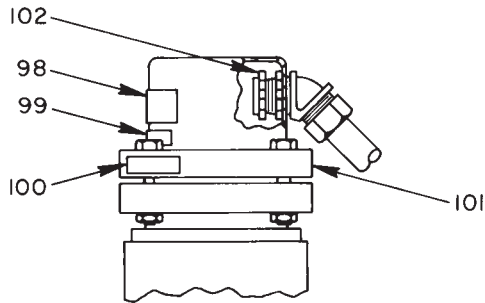
50.200.060.010A

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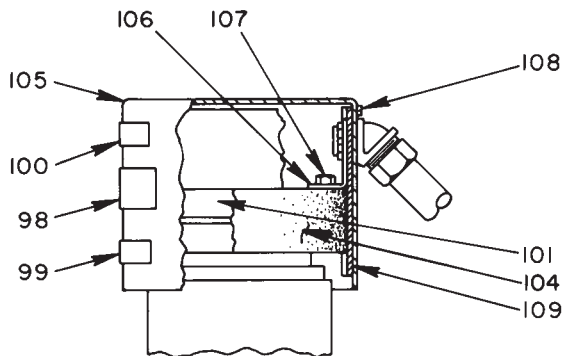
NOTES: FOR DETAILS, SEE DWG. 50.200.060.010B.
FOR PARTS LIST, SEE DWGS. 50.200.060.010C-F.

50-200 EVAPORATOR FOR CHLORINE

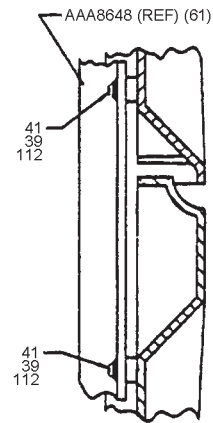
INDOOR HEATER HARDWARE



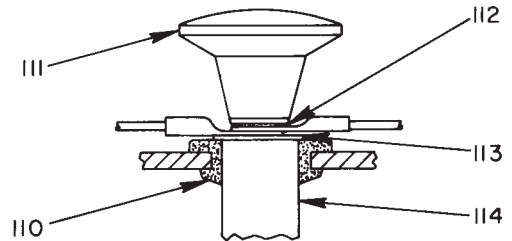
OUTDOOR HEATER HARDWARE



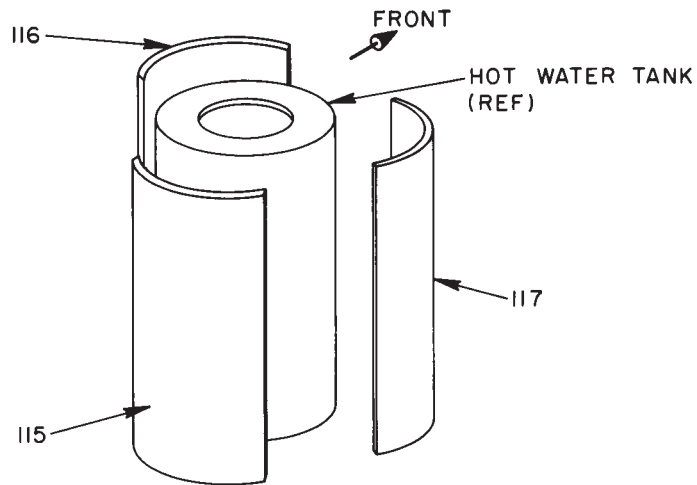
DETAIL "A"



VIEW 1



DETAIL "B"



DETAIL "C"
INSULATION DETAIL

NOTES: FOR PARTS LIST, SEE DWGS. 50.200.060.010C-F.

SERIES 50-200 EVAPORATOR - PARTS

50.200.060.010B

ISSUE 2 7-10

50-200 EVAPORATOR FOR CHLORINE

KEY NO.	PART NO.	QTY.	DESCRIPTION
7	W2T12728	5	Union, 1-1/4" NPT (Iron) x 1-1/4" Solder Cup (Copper)
10	W2T17929	4	Union, 1" NPT (Iron) x 1" Solder Cup (Brass)
13	W2T17930	2	Union, 1/2" NPT (Iron) x 1/2" Solder
14	W2T9105	1	1/2" Solenoid Valve
16	W2T17931	1	Union, 3/4" NPT (Iron) x 3/4" Solder Cup (Brass)
19	W3T110058	3	Union, 1" Ammonia
21	W2T12788	1	Kickplate
22	W2T13288	20	Self-Threading Nut
23	W2T13431	2	Bolt (Hex. Hd., Cad. Plate Steel) 5/8"-11 x 3-1/2" Lg.
25	W2T16384	1	Gasket
26	W2T376320	4	Bolt (Hex. Hd., Cad. Plate Steel) 1/2"-13 x 1-1/4" Lg.
27	W2T17614	4	Washer
28	W2T18054	1	Gasket
29	W2T12243	1	Evaporator Tank
30	W2T13442	1	Standard Cylinder
	OR		
	W2T13505	1	"L" Certified Cylinder
	OR		
	W2T8490	1	MLS Cylinder
32	W2T19518	4	Bolt (Hex. Hd., Steel) 3/8"-16 x 1" Lg.
33	W2T17613	16	3/8" Washer (Steel)
34	W2T19515	8	3/8" Lockwasher (Steel)
35	W2T19519	8	Clamping Nut (Steel) 3/8"-16
36	W2T17750	2	90° Street Elbow (Iron) 1/4" MPT x 1/4" FPT
37	W2T15134	2	Connector (Poly) 1/2" Tube x 1/4" NPT
38	W2T12793	2	Connector (Poly) 1/2" Tube x 1/8" NPT
39	W2T19377	17	Bolt (Hex. Hd., Steel) 1/4"-20 x 5/8" Lg.
40	W2T17612	6	1/4" Washer (Steel)
41	W2T18841	16	1/4" Lockwasher (Steel)
42	W2T16268	4	Locknut, 1-1/4" Conduit
43	W2T18251	2	Seal Ring, 1-1/4" Conduit
44	W2T19645	2	Bushing, 1-1/4" Conduit
45	W2T12570	2	Nipple, 1-1/4" Conduit
46	W2T16789	2	Coupling (Conduit) 1-1/4" NPT
47	W2T8191	1	Bottom Connection Assembly

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

SERIES 50-200 EVAPORATOR - PARTS LIST

50.200.060.010C

ISSUE 1 7-10

50-200 EVAPORATOR FOR CHLORINE

KEY NO.	PART NO.	QTY.	DESCRIPTION
48	W2T17335	10	5/16" Washer (Steel)
50	W2T18983	12	Clamping Nut (Steel) 5/16"-18
51	W2T18542	10	5/16" Lockwasher (Steel)
53	W2T17793	14	Bolt (Hex. Hd., Steel) 5/16"-18 x 1" Lg.
55	W2T16967	4	Bolt (Hex. Hd., Steel) 3/8"-16 x 3/8" Lg.
56	W2T12248	4	Support Channel
57	W2T12749	1	Caplug
58	W2T18792	1	Union Adapter, 1/4" NPT x 5/8"-18
59	W2T18793	1	90° Street Elbow (Steel) 1/4" MPT x 1/4" FPT
61	W2T10373	1	Left-Hand Support Angle
62	W2T12718	4	Insulator
63	W2T12781	2	Support Channel
64	W2T12794	1	Tube Unit
65	W2T11775	2	O-ring (012) Viton, 3/8" ID x 1/2" OD (For Chlorine and Sulphur Dioxide Use Only)
	OR		
	W2T19225	2	O-ring (012) Buna-N, 3/8" ID x 1/2" OD (For Ammonia Use Only)
72	W2T10372	1	Right-Hand Support Angle
73	---	1	Water Level Control Components (Ref. Dwg. 50.200.000.020)
74	W2T15096	1	Inlet Label
75	W2T12802	1	Heater Body
76	W2T12491	1	Temperature Switch with Round Housing
	OR		
	W2T414743	1	1/2" NPT Plug
77	W2T297488	1	Temperature Switch with Square Housing
	OR		
	W2T414743	1	1/2" NPT Plug
82	W2T12709	1	Pump Guard
83	W2T17387	2	Mach. Screw (Steel, Rd. Hd.) 10-24 x 3/8" Lg.
84	W2T12776	1	Centrifugal Pump
86	W2T15113	1	Outlet Label
● 87	W2T14646	1	Gas Pressure Gauge (Chlorine Use Only)
	OR		
	W3T109319	1	Gas Pressure Gauge (Ammonia and Sulfur Dioxide Use Only)

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

SERIES 50-200 EVAPORATOR - PARTS LIST

50.200.060.010D

ISSUE 1 7-10

50-200 EVAPORATOR FOR CHLORINE

KEY NO.	PART NO.	QTY.	DESCRIPTION
88	W2T12753	2	Gasket
89	W2T12751	1	Name Plaque
90	W2T376237	8' 7-13/16"	"U" Channel, Extruded Rubber
91	W3T110054	1	Purgemeter (Ref. Dwg. 50.200.000.040)
93	---	1	Control Enclosure (Ref. Dwg. 50.200.060.020)
94	W2T10512	1	Logo, Front Panel, Upper
95	W2T365022	1	Front Panel, Lower
97	W2T16293	1	Gas Temperature Gauge
98	W2T15353	1	Warning Label
99	W2T12976	1	Caution Label
100	W2T13501	2	Warning Label
■ 101	W2T415793	1	Heat Exchanger (208 V, 60 A)
	OR		
	W2T12741	1	Heat Exchanger (220/240 V, 60 A)
	OR		
	W2T12736	1	Heat Exchanger (380 V, 30 A)
	OR		
	W2T12799	1	Heat Exchanger (440/480 V, 30 A)
	OR		<u>8,000 PPD Capacity</u>
	W2T415796	1	Heat Exchanger (550 V, 30 A)
	OR		
	W2T12697	1	Heat Exchanger (208 V, 60 A)
	OR		
	W2T12798	1	Heat Exchanger (220/240 V, 60 A)
	OR		
	W2T12698	1	Heat Exchanger (380 V, 30 A)
	OR		
	W2T12797	1	Heat Exchanger (440/480 V, 30 A)
	OR		<u>10,000 PPD Capacity</u>
	W2T415798	1	Heat Exchanger (550 V, 30 A)
	OR		
	W2T12740	1	Heat Exchanger (440/480 V, 30 A)
	OR		
	W2T9300	1	Heat Exchanger (380 V, 30 A)

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

SERIES 50-200 EVAPORATOR - PARTS LIST

50.200.060.010E

ISSUE 3 5-10

50-200 EVAPORATOR FOR CHLORINE

KEY NO.	PART NO.	QTY.	DESCRIPTION
102	W2T19644	1	1" Conduit Bushing
104	W2T14847	1	Gasket
105	W2T12244	1	Heater Cover
106	W2T12247	1	Heater Connector Angle
107	W2T16961	1	Bolt (Hex. Hd., Steel) 1/2"-13 x 3/4" Lg.
108	W2T14797	1	Sheet Metal Screw (Oval Hd. Steel) #10 x 1/2" Lg.
109	W2T12246	1	Cover Plate
110	W2T18489	4	Grommet
111	W2T19459	4	Knob
112	W2T16829	14	1/2" Washer (Steel)
113	W2T18488	4	Washer (Brass)
114	W2T18490	4	Anode
115	W2T12700	1	Tank Insulation (Rear)
116	W2T12699	1	Tank Insulation (Right)
117	W2T12701	1	Tank Insulation (Left)
118	W2T16677	2	#10 Lockwasher (Steel)
119	W2T16376	2	#10 Washer (Steel)
120	W2T12578	2	Grommet

- NOTE:**
- Key #65 should be replaced each time #87 is replaced.
 - The control panel components were selected to power the original heater capacity. Never replace the original heater with another voltage or capacity.
- All Steel Piping is 1" (Schedule 80) as Per ASTM 1-106, Grade B.
- All Polypropylene Tubing is 1/2" OD x 1/16" Wall (Working Pressure: 250 PSI).
- All Copper Tubing is 1/2", 3/4", 1", or 1-1/4" (Seamless, Type M) as Per ASTM B-88 or Equivalent.
- All Flexible Conduit is 1/2" or 1" (Steel, Liquid Tight) with Appropriate Connectors & Fittings (Meets JIC Requirements).

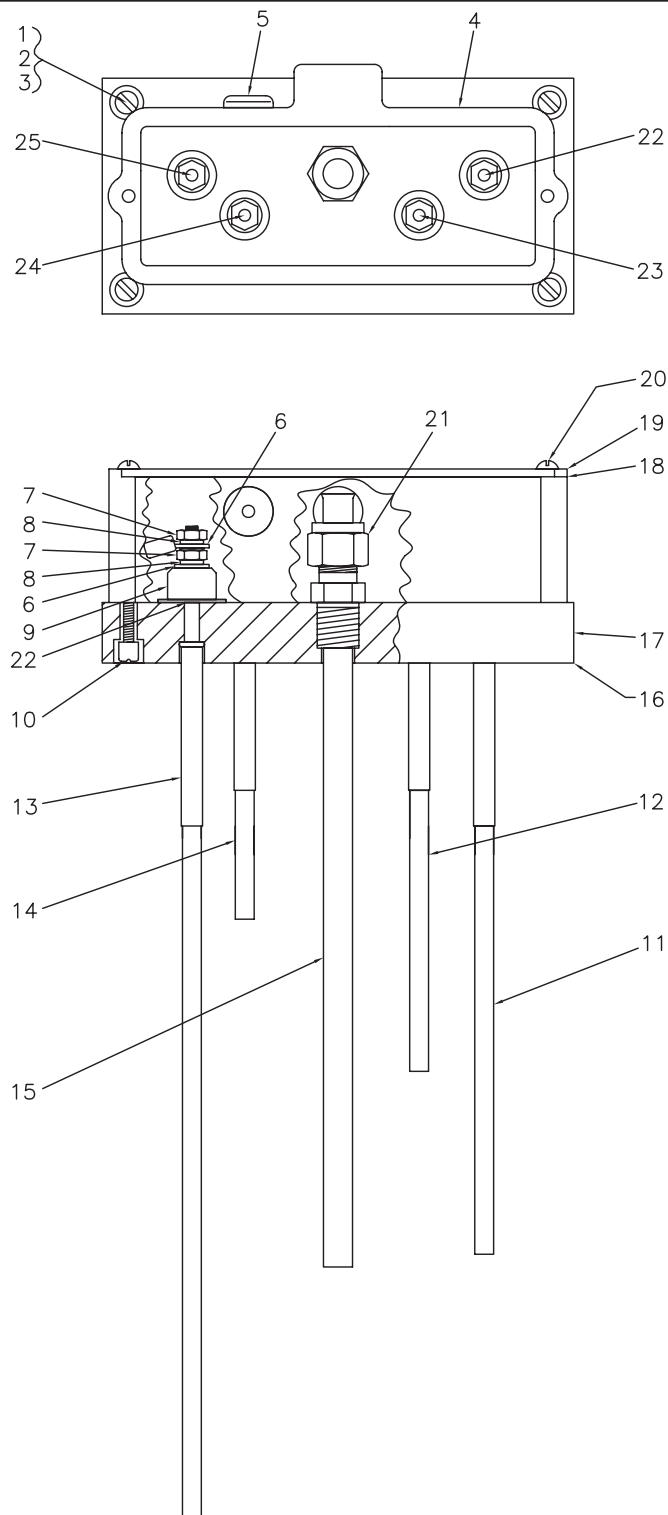
WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

SERIES 50-200 EVAPORATOR - PARTS LIST

50.200.060.010F

ISSUE 1 4-11

50-200 EVAPORATOR FOR CHLORINE



NOTE: FOR PARTS LIST, SEE DWG. 50.200.000.020B.

WATER LEVEL AND TEMPERATURE CONTROL PROBES - PARTS
For Series 50-200 Evaporator

50.200.000.020A

ISSUE 1 7-10

50-200 EVAPORATOR FOR CHLORINE

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	W2T18421	4	Mach. Screw (Ph. Hd., SS) #10-24 x 1" Lg.
2	W2T17002	4	#10 Washer (SS)
3	W2T16386	4	#10 Lockwasher (SS)
4	W2T12748	1	Probe Housing
5	W2T12717	1	Grommet
6	W2T13770	8	#8 Washer (SS)
7	W2T16604	8	Hex. Nut (SS) #8-32
8	W2T11881	8	#8 Lockwasher (SS)
9	W2T13172	4	Insulator Bushing
10	W2T16475	2	Mach. Screw (Ph. Hd., SS) #8-32 x 3/4" Lg.
11	W3T109328	1	Level Probe
12	W3T109324	1	Level Probe
13	W3T109331	1	Level Probe
14	W3T109321	1	Level Probe
15	W3T107903	1	Temperature Probe
16	W2T12752	1	Mounting Pad Gasket
17	W2T12747	1	Mounting Pad
18	W2T15004	1	Gasket
19	W2T15005	1	Cover
20	W2T17503	2	Mach. Screw (Rd. Hd., SS) #8-32 x 1/2" Lg.
21	W2T12725	1	Temperature Probe Holder
22	W2T8499	1	Washer, Nylon, Red
23	W2T8500	1	Washer, Nylon, Green
24	W2T8498	1	Washer, Nylon, Blue
25	W2T8501	1	Washer, Nylon, Yellow

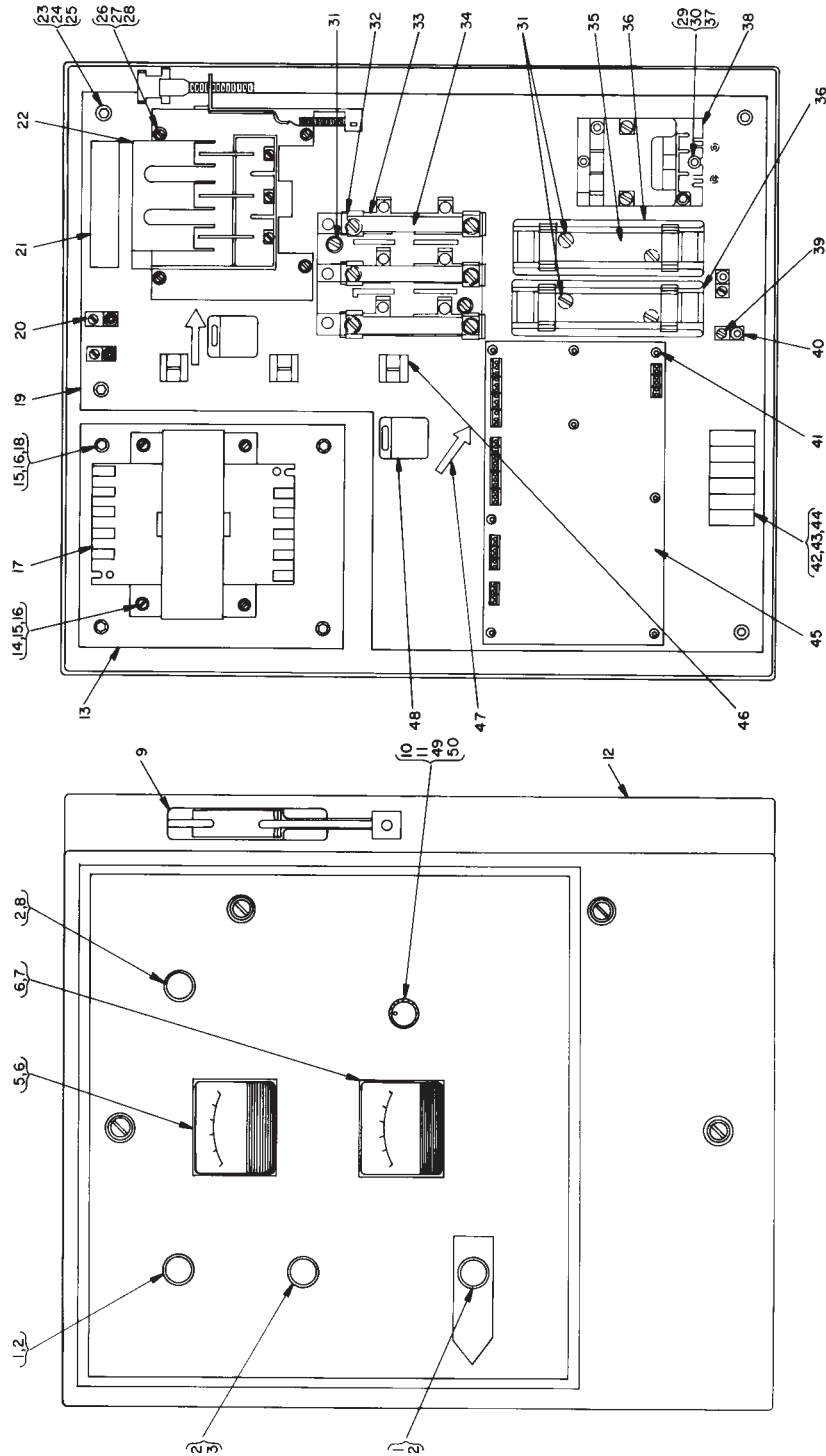
WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

WATER LEVEL AND TEMPERATURE CONTROL PROBES - PARTS LIST
For Series 50-200 Evaporator

50.200.000.020B

ISSUE 1 7-10

50-200 EVAPORATOR FOR CHLORINE



NOTES: FOR PARTS LIST, SEE DWGS. 50.200.060.020B&C.

W2T365042 CONTROLS ENCLOSURE - PARTS

50.200.060.020A

ISSUE 1 7-10

50-200 EVAPORATOR FOR CHLORINE

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	W2T12729	2	Indicator Light, Red
●2	W2T12731	4	Lamp
3	W2T12730	1	Indicator Light, Amber
5	W2T12734	1	Tempmeter
6	W2T12754	2	Gasket
7	W2T12735	1	Ammeter
8	---	1	Indicator Light, Green
9	W2T14713	1	Operating Handle
10	W2T12723	1	Potentiometer
11	W2T18282	1	Knob
13	W2T12744	1	Transformer Mounting Panel
14	W2T16587	4	Mach. Screw (Rd., Hd., SS) 5/16"-18 x 1/2" Lg.
15	W2T16484	8	5/16" Washer (SS)
16	W2T16687	8	5/16" Lockwasher (SS)
17	W2T12774	1	Transformer
18	W2T19258	4	Mach. Screw, (Hex. Hd., SS) 5/16"-18 x 1" Lg.
19	W2T12745	1	Mounting Plate
20	W2T12756	1	Connector, Locktite
▲21	W2T12765	1	Marker (208 V)
	OR		
	W2T12768	1	Marker (220 V)
	OR		
	W2T12769	1	Marker (240 V)
	OR		
	W2T12766	1	Marker (380 V)
	OR		
	W2T12770	1	Marker (440 V)
	OR		
	W2T12764	1	Marker (480 V)
	OR		
	W2T12767	1	Marker (550 V)
22	W2T12724	1	Disconnect Switch
23	W2T376050	6	Mach. Screw (Hex. Hd., SS) 1/4"-20 x 5/8" Lg.
24	W2T12020	6	1/4" Washer (SS)
25	W2T12013	6	1/4" Lockwasher (SS)

NOTE: ● PART OF KEY NUMBERS 1, 3 OR 8.

▲ NOT PART OF W2T365042.

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

W2T365042 CONTROLS ENCLOSURE - PARTS LIST

50.200.060.020B

ISSUE 1 7-10

50-200 EVAPORATOR FOR CHLORINE

KEY NO.	PART NO.	QTY.	DESCRIPTION
26	W2T17476	6	Mach. Screw (Rd. Hd., SS) #10-24 x 3/8" Lg.
27	W2T17002	4	#10 Washer (SS)
28	W2T16386	4	#10 Lockwasher (SS)
29	W2T17476	4	Mach. Screw (Rd. Hd., SS) #10-24 x 3/8" Lg.
30	W2T17002	4	#10 Washer (SS)
31	W2T19574	6	Mach. Screw (Rd. Hd., SS) #10-24 x 3/4" Lg.
▲32	W2T12772	1	30 A Fuse Clip Kit (Used for 440/480, 550 V 380 Low & Med)
	OR		
	W2T12773	1	60 A Fuse Clip Kit (Used for 208, 220/240, 380 V High)
33	W2T12778	1	Fuse Block
▲34	W2T19607	3	30 A Heater Fuse (380 V Low & Med, 440, 480 & 550 V)
	OR		
	W2T9299	3	35 A Heater Fuse (380 V 10,000 PPD High Capacity)
	OR		
	W2T14835	3	60 A Heater Fuse (280, 220 & 240 V)
▲35	W2T12800	1	7 A Transformer Fuse (Used for 308, 220/240 V)
	OR		
	W2T12733	1	3-1/2 A Transformer Fuse (Used for 380 V)
	OR		
	W2T12732	1	3 A Transformer Fuse (Used for 440/480, 550 V)
36	W2T12801	2	Fuse Block
37	W2T16386	3	#10 Lockwasher (SS)
▲38	W2T12727	1	60 A Contactor (Used for 208, 220/240, 380 V High)
	OR		
	W2T12777	1	30 A Contactor (Used for 440/480, 550 V 380 Low & Med)
39	W2T19386	4	Mach. Screw (Rd. Hd., SS) 1/4"-20 x 1/2" Lg.
40	W2T15609	2	Ground Connector
41	W2T12714	8	Circuit Board Support
42	W2T18961	1	Terminal Block
43	W2T18552	2	Mach. Screw (Rd. Hd., Brass) #8-32 x 1" Lg.
44	W2T17385	2	#8 Washer (Brass)
45	W2T12779	1	Level Control Board
46	W2T13406	3	Wire Clamp
47	W2T15234	2	Arrow Label
48	W2T12676	2	Warning Label
49	W2T18670	1	3/8" Lockwasher (SS)
50	W2T17475	1	Mounting Nut (Brass) 3/8"-32 x 1/2"

NOTE: ▲ NOT PART OF W2T365042.

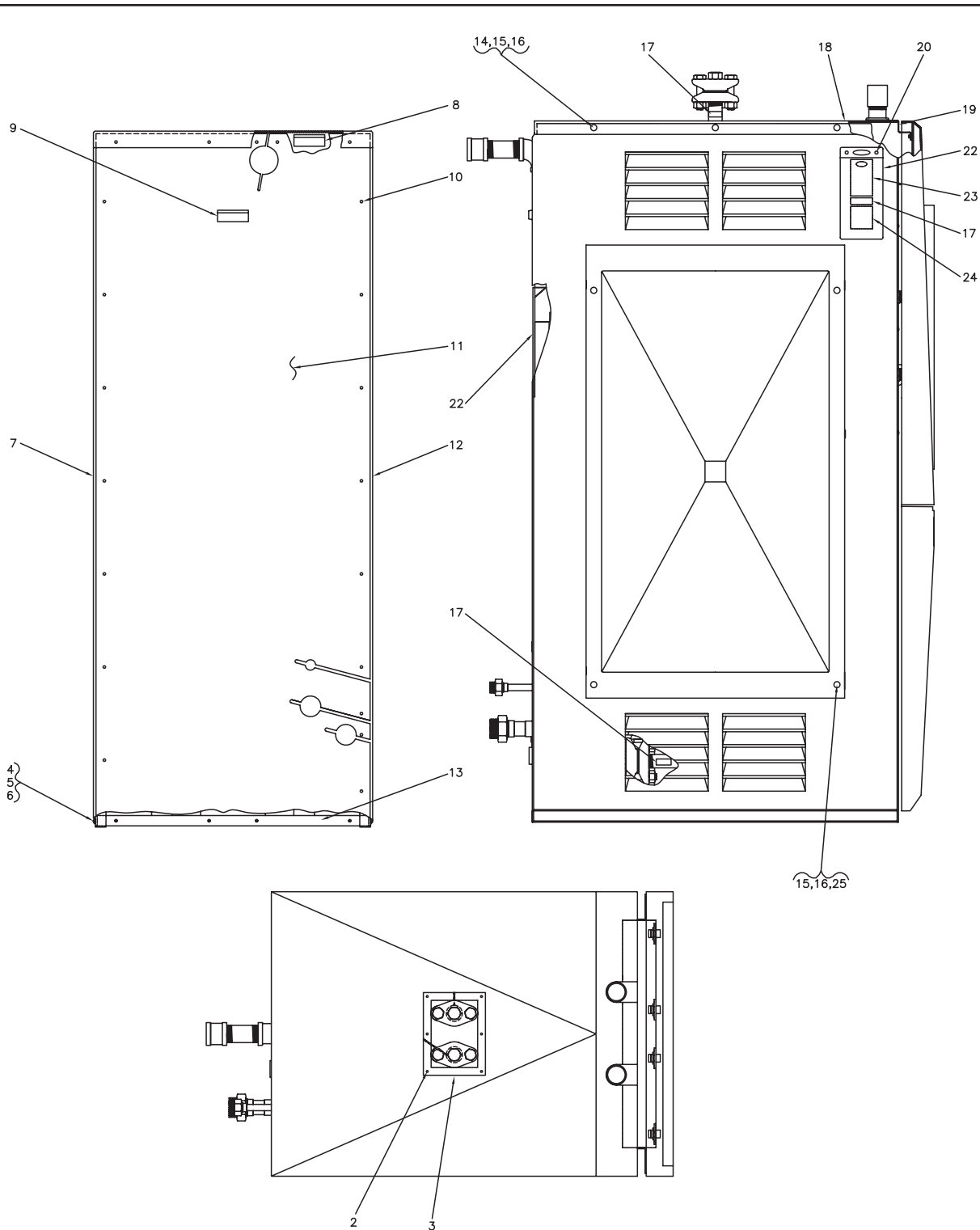
WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

W2T365042 CONTROLS ENCLOSURE - PARTS LIST

50.200.060.020C

ISSUE 1 4-11

50-200 EVAPORATOR FOR CHLORINE



NOTES: FOR PARTS LIST, SEE DWG. 50.200.060.030B.

ENCLOSURE - PARTS
50.200.060.030A
ISSUE 1 7-10

50-200 EVAPORATOR FOR CHLORINE

KEY NO.	PART NO.	QTY.	DESCRIPTION
2	W2T13299	6	Push Clip
3	W2T12242	1	Cover, Top Pipe
4	W2T19068	2	Mach. Screw (Ph. Hd., SS) #10-24 x 7/8" Lg.
5	W2T17002	2	#10 Washer (SS)
6	W2T16386	2	#10 Lockwasher (SS)
▲7	W2T441385	1	Right-Hand-Side Enclosure
8	W2T12976	1	Label, Caution
●9	W2T12976	1	Label, Caution
●10	W2T13299	25	Push Clip
●11	W2T10405	1	Rear Panel
▲12	W2T441384	1	Left-Hand-Side Enclosure
13	W2T10344	1	Rear Brace
14	W2T12241	6	Receptacle
15	W2T12760	14	Stud
16	W2T12757	14	Retainer
17	W2T14224	4	Label (Ammonia Use Only)
	OR		
	W2T11771	4	Label (Chlorine Use Only)
	OR		
	W2T12771	4	Label (Sulfur Dioxide Use Only)
▲18	W2T441382	1	Top Enclosure
19	W2T10371	1	Bracket
20	W2T16866	2	Self-Tap Screw (Type F, Steel) #10-24 x 1/2" Lg.
22	W2T13515	2	Warning Card (Chlorine Use Only)
	OR		
	W2T13516	2	Warning Card (Hazardous Chemical)
23	W2T15483	1	Label, Warning
24	W2T13514	1	Label, Caution
25	W2T12759	8	Receptacle

NOTE: ● PART OF W3T97878 OPTIONAL PARTS GROUP FOR OUTDOOR USE.
▲ ALL THREE ARE INCLUDED IN W2T365062.

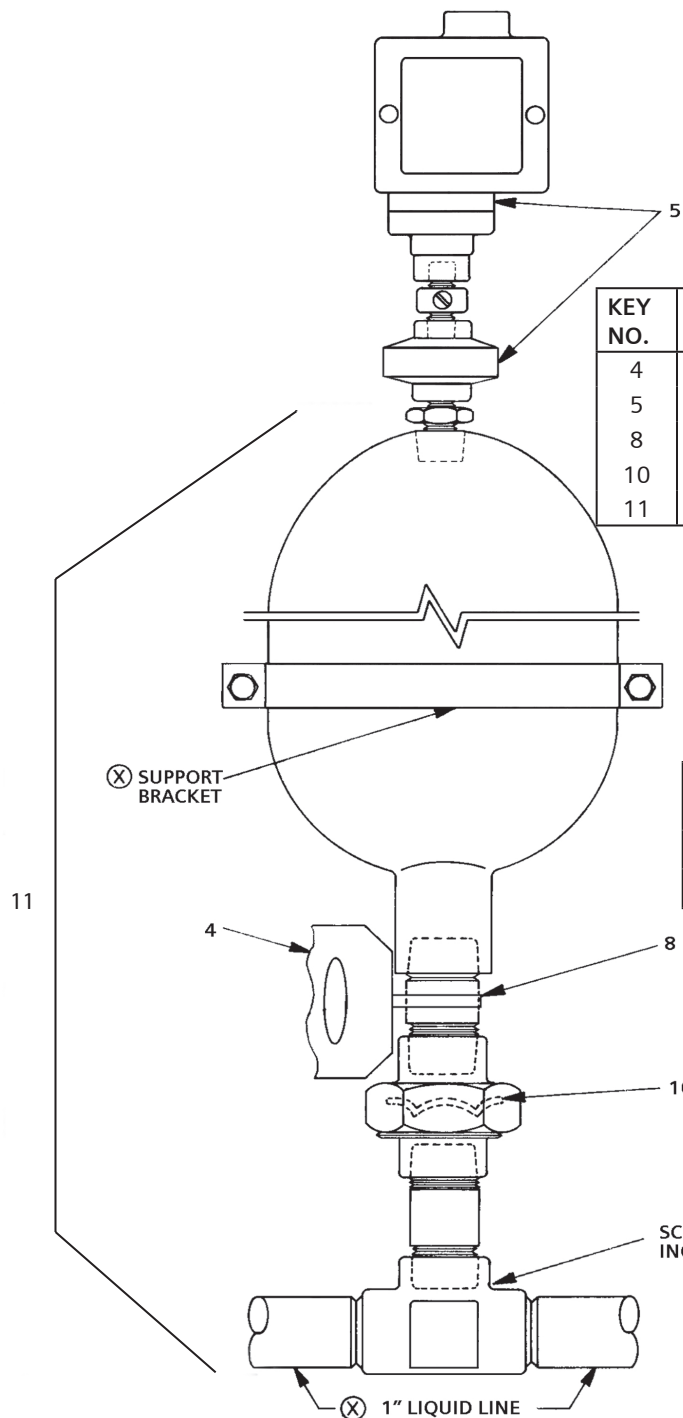
WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

ENCLOSURE - PARTS LIST

50.200.060.030B

ISSUE 1 4-11

50-200 EVAPORATOR FOR CHLORINE



KEY NO.	PART NO.	DESCRIPTION
4	W2T13513	Warning Label
5	W2T15225	Pressure Switch and Diaphragm Seal
8	W2T18146	Clamp Band
10	W2T15213	Rupture Disc
11	W2T8247	System Pressure Relief Sub-Assmebly

The length of liquid line protected per expansion chamber system.

PIPE SIZE	CHLORINE	SULFUR DIOXIDE	AMMONIA
1"	375'	435'	355'
3/4"	625'	720'	560'

SCH 80 FORGED STEEL 1" NPT TEE INCLUDED IN KEY #11

NOTE: USE LITHARGE AND GLYCERIN CEMENT OR OTHER CEMENT APPROVED BY THE CHLORINE INSTITUTE.
(X) NOT FURNISHED BY EVOQUA WATER TECHNOLOGIES

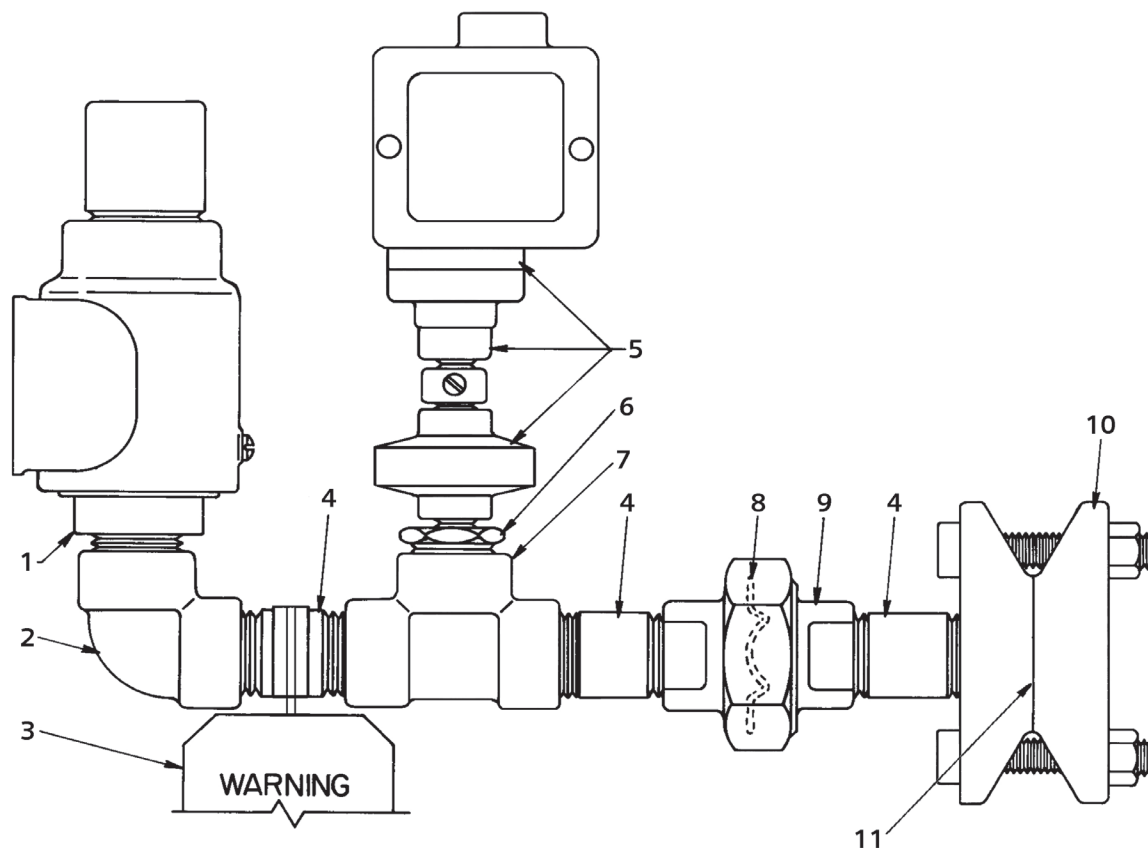
WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

W3T99062 LINE PRESSURE RELIEF SYSTEM - PARTS

50.202.007.011

ISSUE 5 8-14

50-200 EVAPORATOR FOR CHLORINE



KEY NO.	PART NO.	QTY.	DESCRIPTION
1	W2T14850	1	Relief Valve
2	W2T19550	1	Elbow 90° x 1" NPT (Forged Steel)
3	W2T13513	1	Warning Label
4	W2T17357	3	Nipple 1" NPT x 3/4" Lg. (Steamless Carbon Steel)
5	W2T15225	1	Pressure Switch and Diaphragm Seal
6	W2T15345	1	Reducing Bushing 1" NPT x 1/4" NPT (Forged Steel)
7	W2T16684	1	Tee 1" NPT (Forged Steel)
8	W2T15213	1	Rupture Disc
9	W2T15227	1	Union Type Safety Head
10	W3T110058	1	Ammonia Union 1" NPT
11	W2T16384	1	Lead Gasket

NOTE: USE LITHARGE AND GLYCERIN CEMENT, W2T17084, OR OTHER CEMENT APPROVED BY THE CHLORINE INSTITUTE.

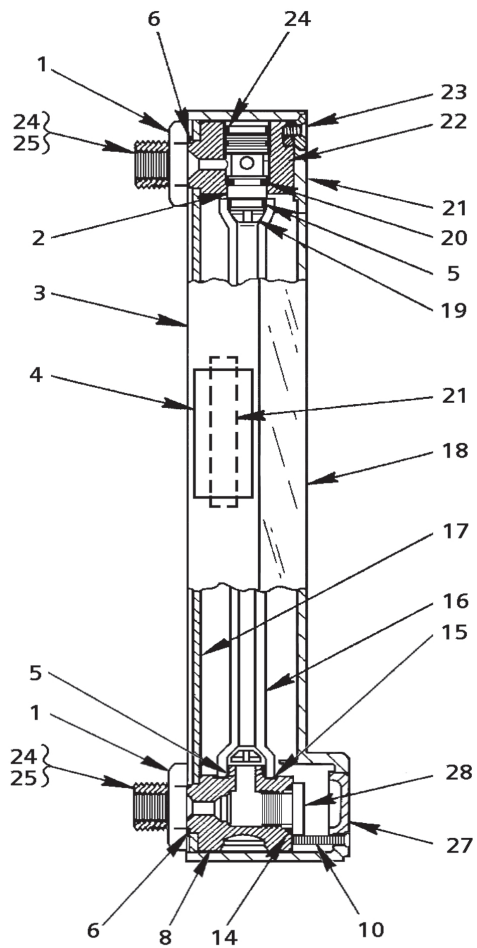
WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

W3T97782 GAS PRESSURE RELIEF SYSTEM - PARTS

50.202.008.011

ISSUE 4 7-10

50-200 EVAPORATOR FOR CHLORINE



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

SERIES 510-050 FLOWMETER - PARTS
Model 150 - 6"

55.200.000.040A

ISSUE 0 7-10

50-200 EVAPORATOR FOR CHLORINE

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	W2T12710	2	Locknut (9/16"-18)
2	W2T375587	1	Tube Retainer
3	W2T12743	1	Frame
4	W2T12763	1	Warning Label (SS)
5	W2T12008	2	O-ring (010) 1/4" ID x 3/8" OD (EPR)
6	W2T12677	2	Retaining Ring, External
8	W2T12705	1	End Fitting (Bottom) (SS)
10	W2T12713	2	Mach. Screw (Fl. Hd., SS) #4-40 x 7/8" Lg.
14	W2T15450	1	O-ring (013) 7/16" ID x 9/16" OD (EPR)
15	W2T375537	1	Cushion
16	W2T13474	1	Metering Tube
17	W2T12719	1	Backer Strip
18	W2T375589	1	Cover
19	W2T375604	1	Flow Insert
20	W2T13320	1	O-ring (011) 5/16" ID x 7/16" OD (EPR)
21	W2T12707	1	Namplate
22	W2T12706	1	End Fitting (Top) (SS)
23	W2T12712	2	Mach. Screw (Fl. Hd., SS) #4-40 x 3/8" Lg.
24	W2T18045	1	O-ring (012) 3/8" ID x 1/2" OD (EPR)
25	W2T12722	2	Seat, High Cap. (SS)
27	W2T12721	1	Cover Cap
28	W2T12720	1	Plug, Kynar

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

SERIES 510-050 FLOWMETER - PARTS
Model 150 - 6"

55.200.000.040B

ISSUE 0 7-10

SECTION 6

50-200 EVAPORATOR FOR CHLORINE

SECTION 6 - SPARE PARTS LIST

QTY.	DESCRIPTION	PART NO.
1	Spare Parts Kit (replacement gaskets)	W3T110050
1	Cylinder Gasket, Top Flange	*W2T18796
6	Gaskets for Ammonia Type Union	*W2T16384
2	O-ring for Gauge Line (Chlorine gas pressure)	*W2T11775
1	Gasket for Water Tank	*W2T18054
1 lb.	Sodium Sulfate, Cathodic Protection	W2T15555
1	Drying Kit	W3T109990
2	Rupture Disc (Liquid Line 400 psi)	W2T15213
4	Anode, Cathodic Protection	W2T18490
4	Ferrule 1" Dielectric Union	*W2T365255
4	Gasket 1" Dielectric Union	*W2T365256
5	Ferrule 1-1/4" Dielectric Union	*W2T365257
5	Gasket 1-1/4" Dielectric Union	*W2T365258
1	Wrench	W2T18620
1	Bottle of Ammonia Solution for Chlorine Leak Detection	W2T11994
1	Circulator Pump Repair Kit (minus shaft seal)	W2T8999
1	Circulator Shaft Seal	W2T12795
1	Circulator Shaft Gasket	W2T8998
1	Lamp (replacement bulb)	W2T12731

*Part of Spare Kit W3T110050.

SECTION 7

CHLORINE HANDLING MANUAL

(Cl₂)

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

CHLORINE HANDLING MANUAL

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

CHLORINE HANDLING MANUAL

WARNING:

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

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

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

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

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

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CHLORINE HANDLING MANUAL

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1 INTRODUCTION

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

WARNING:

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

WHEN WORKING WITH CHLORINE:

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

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

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

IN CASES OF ACCIDENT:

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

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

TO AVOID ACCIDENTAL GAS RELEASE:

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

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

LOCAL LAWS:

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

CHLORINE HANDLING MANUAL

2 TECHNICAL DATA AND CHARACTERISTICS OF CHLORINE

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

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

Specific Gravity, Dry Gas

2.48 at 32° F and 1 atm referred to air.

Specific Gravity, Liquid

1.47 at 32° F and 53 . 5 psia.

Liquid to Gas volume Ratio

1:456.5 at 32° F and 1 atm.

Latent heat of Vaporization

123.9 Btu per lb at boiling point, -29.2° F.

Specific Volume, Dry Gas

1 lb = 4.99 of at 32° F and 1 atm.

Specific Volume, Liquid

1 lb = 0.0109 cf at 32° F and 53.5 psia.

Weight, Dry Gas

1 cf = 0.2006 lb at 32° F and 1 atm.

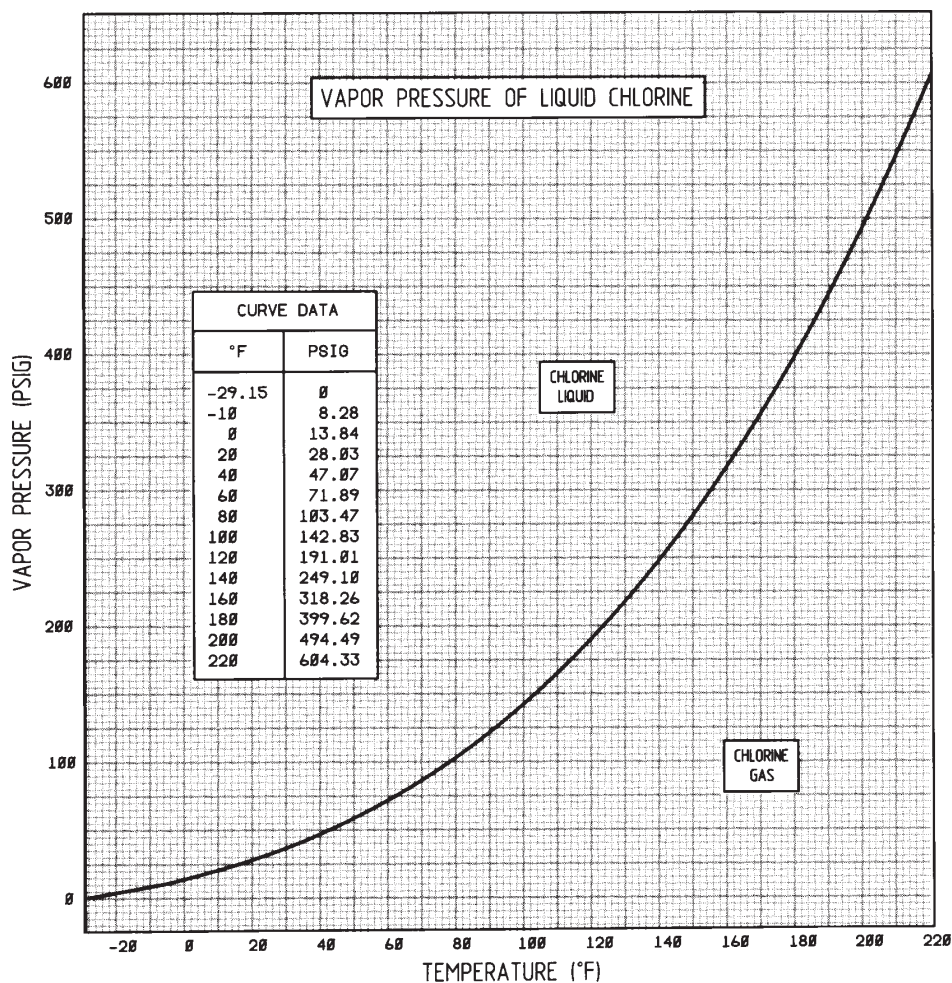


Figure 1 – Chlorine Pressure vs Temperature

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

CHLORINE HANDLING MANUAL

Weight, Liquid

1 cf = 91.56 lb at 32° F.

Solubility in Water*

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

Pressure vs Temperature

See Figure 1

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

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

3 SUPPLY CONTAINERS

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

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

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

3.1 RATES

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

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

3.1.1 MANIFOLDING FOR GAS WITHDRAWAL

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

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

TABLE 1 - CHLORINE CONTAINER INFORMATION

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

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

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

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

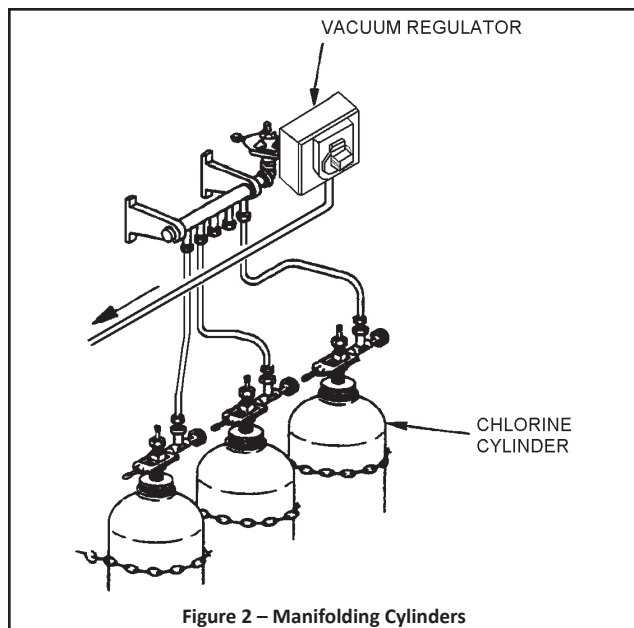


Figure 2 – Manifolding Cylinders

3.2 MAXIMUM LIQUID WITHDRAWAL RATE

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

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

3.2.1 MANIFOLDING FOR LIQUID WITHDRAWAL

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

3.3 CONTAINER VALVES

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

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

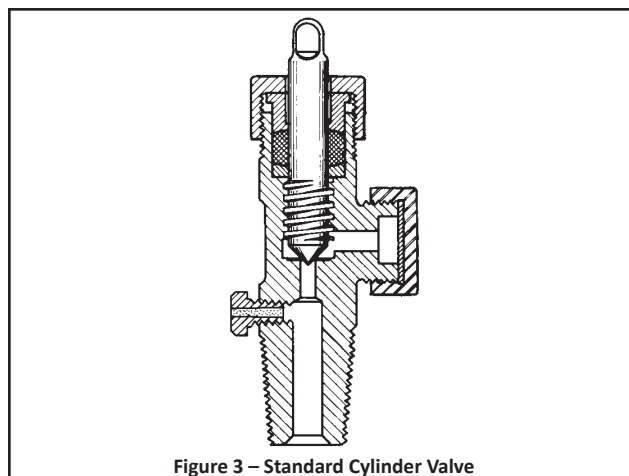


Figure 3 – Standard Cylinder Valve

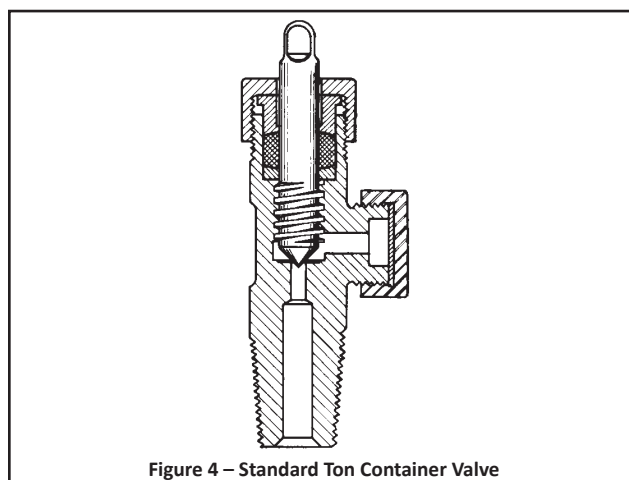


Figure 4 – Standard Ton Container Valve

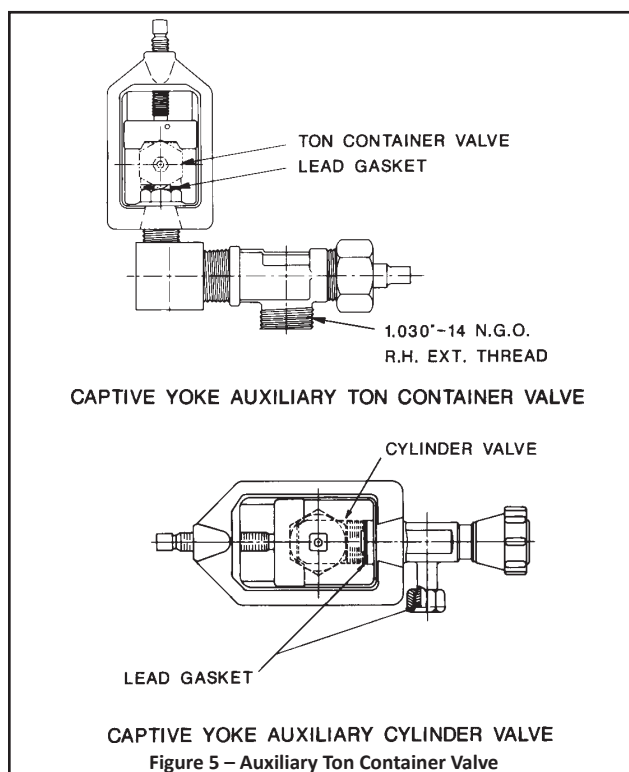
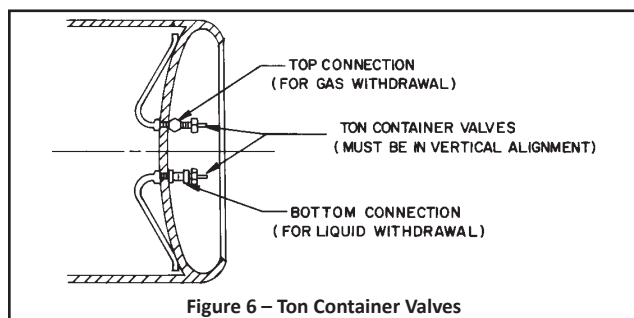
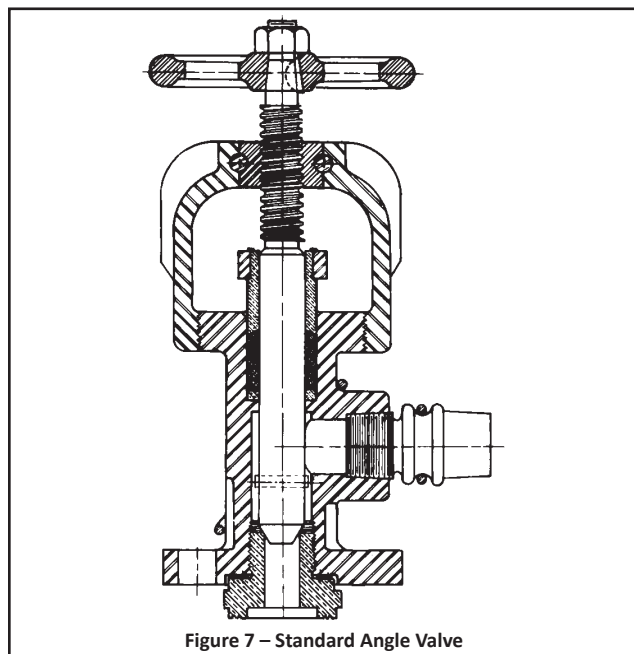


Figure 5 – Auxiliary Ton Container Valve

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



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.



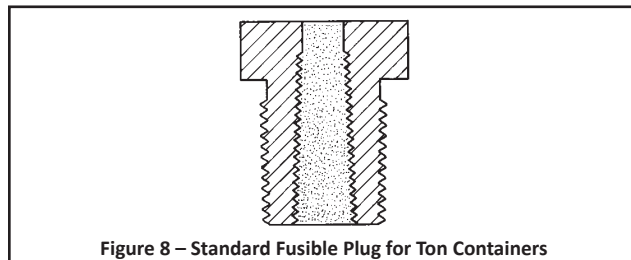
Outlet is one-inch female ANSI Standard taper pipe thread. The liquid withdrawal valves are located on the longitudinal center line of the tank car. The valves on the transverse center line are connected to the vapor space and are used to obtain chlorine gas under pressure for testing the piping or for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

3.4 PRESSURE RELIEF DEVICES

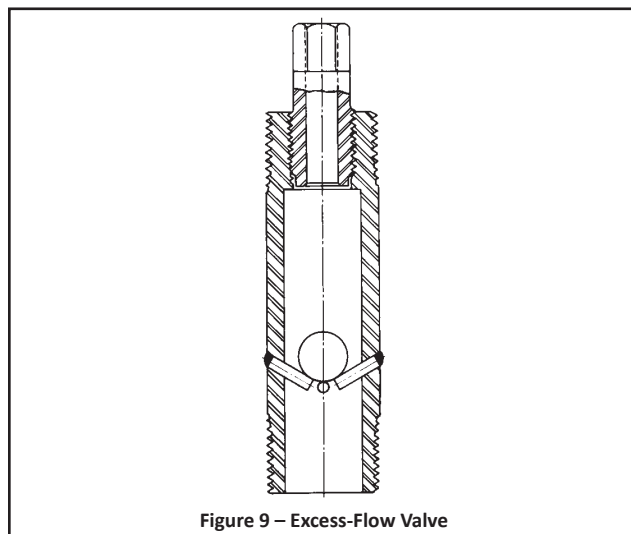
All chlorine supply containers are equipped with some type of device for relief of pressure. Cylinder valves have a fusible metal plug screwed into the body of the valve, as shown in Figure 3. The fusible metal melts when the temperature

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.



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.



3.5 STORAGE OF CONTAINERS

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

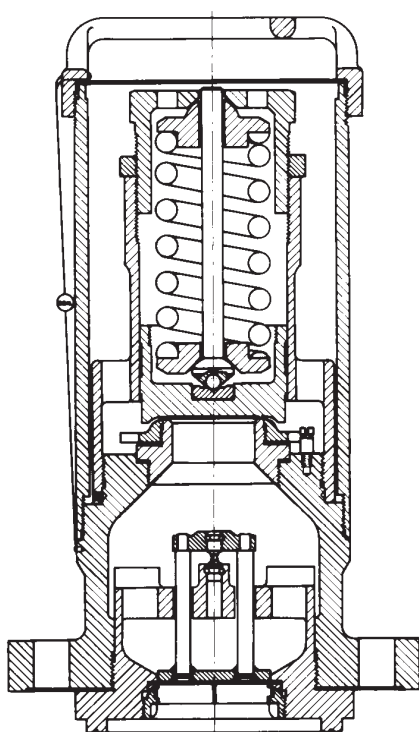


Figure 10 – Standard Safety Relief Device

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

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

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

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

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

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

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

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

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

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

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

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

3.6 HANDLING CONTAINERS

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

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

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

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

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

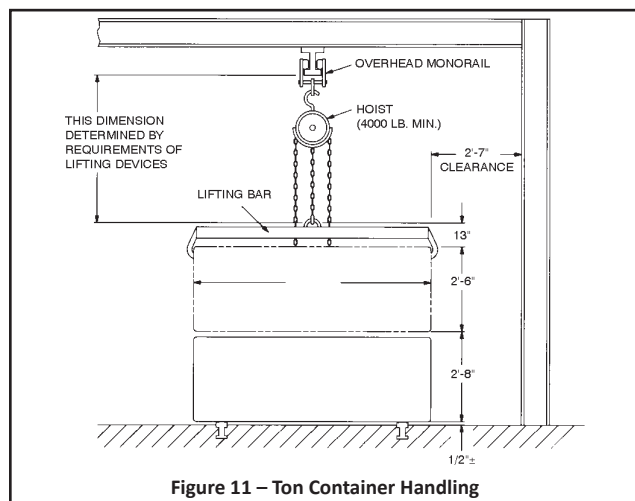


Figure 11 – Ton Container Handling

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

3.7 USING CONTAINERS

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

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

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

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

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

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

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

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

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

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

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

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

4 PIPING

4.1 PIPING MATERIALS AND JOINTS

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

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

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

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

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

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

WARNING: TWO COMMON CAUSES OF CHLORINE PIPING LEAKS ARE:

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

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

4.2 GAS PIPING INSTALLATION REQUIREMENTS

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

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

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

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

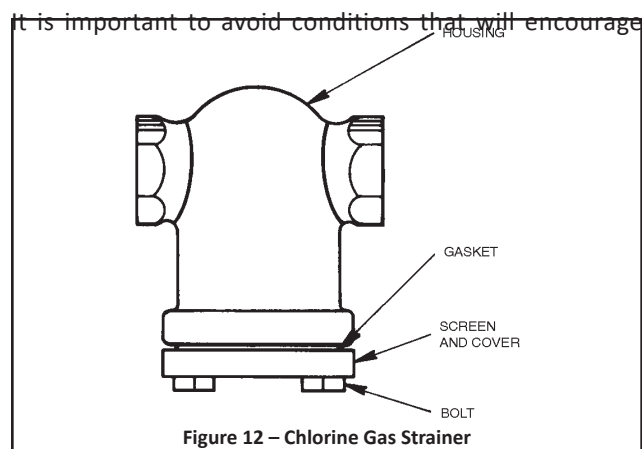
It is preferable to run chlorine pressure gas lines overhead through relatively warm areas rather than along the floor or through basement areas where lower temperatures may be encountered. Do not run these gas lines along exterior walls that may be cold in winter months. Do not run pressure gas lines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

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

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

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

4.3 LIQUID PIPING INSTALLATION REQUIREMENTS

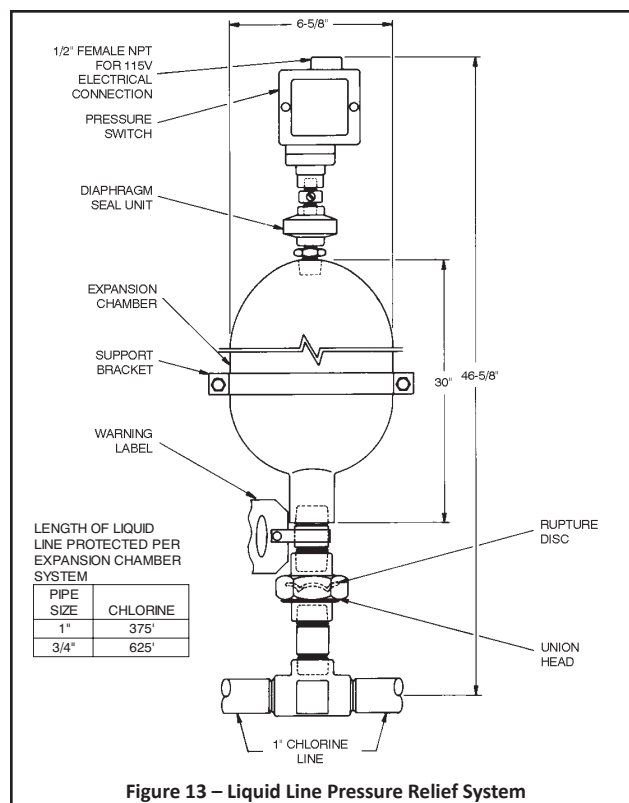


vaporization. Thus it is important to keep liquid chlorine lines as cool as, or cooler than, the containers themselves by eliminating restrictive fittings and always operating with fully opened line valves. Avoid running liquid chlorine lines through overheated areas where gasification is likely.

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

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

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



4.4 PRESSURE RELIEF AND VENT PIPING REQUIREMENTS

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

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

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

4.7 PRESSURE RELIEF DEVICES

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

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

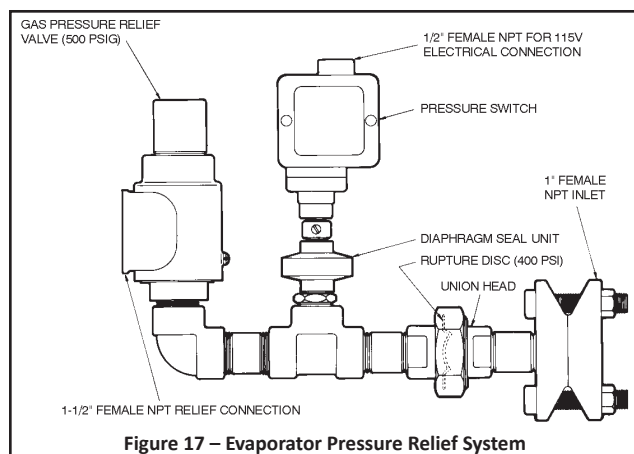


Figure 17 – Evaporator Pressure Relief System

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

4.8 PREPARATION FOR USE

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

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

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

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

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

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

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

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

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

the discharge of chlorine through any leaks.

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

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

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

5 PERSONNEL SAFETY

5.1 GENERAL

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

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

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

In all cases, installations must comply with appropriate regulations.

5.2 HEALTH HAZARDS

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

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

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

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

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

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

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

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

5.3 SAFETY PRECAUTIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

5.4 EMERGENCY ACTION PLANS

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

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

Some chlorine leaks are minor but all require immediate attention.

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

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

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

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

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

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

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

5.5 CHEMICAL DISPOSAL FACILITIES

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

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

Absorption systems have been provided at some facilities to permit a leaking container to be emptied quickly if this is deemed essential. One pound of chlorine can be absorbed by 1. 4 pounds of sodium hydroxide (caustic soda), 3.7 pounds of sodium carbonate (soda ash), or 1.3 pounds of calcium hydroxide (hydrated lime).

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

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

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

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

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

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