

Ozone Systems

Installation & Operation Manual

A4e • A8e • A15e

Corona Discharge Ozone Generator



Tested and certified by
WQA to NSF/ANSI 50 as a
component only.

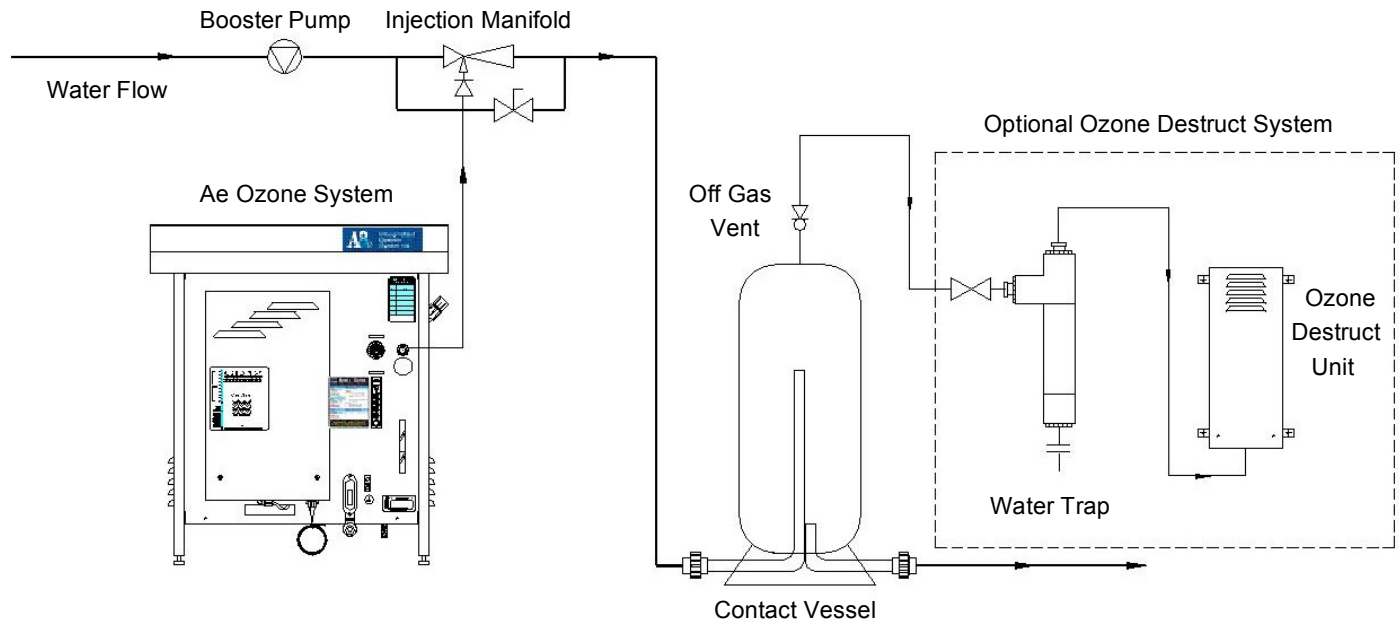
ClearWater Tech, LLC.
Integrated Ozone Systems

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THEORY OF OPERATION/PRODUCT DESCRIPTION CHAPTER 1

ClearWater Tech ozone systems are designed for safe, effective use in a variety of water treatment applications. The A4e, A8e, and A15e ozone generators have been tested and certified by the Water Quality Association according to NSF/ANSI 50. Each complete, integrated system may include the following components required for reliable, efficient ozone production and can be divided into four general segments:

- Air preparation system
- Ozone generator
- Ozone injection/contacting
- Ozone destruct



Air Preparation System

Shown: ClearWater Tech A8e Ozone Systems

ClearWater Tech Ae Series ozone generators require a source of clean, dry, oil-free, oxygen-enriched air for effective ozone production. To meet that need, the built-in air preparation system employs pressure swing adsorption (PSA) technology with oil-less compressor to increase the concentration of oxygen and reduce the moisture content in the feed gas (the air supplied to the ozone generator). This substantially improves the output capability of the ozone generator and prevents premature failure of key internal components. These air preparation systems deliver 90%+/-3% oxygen purity at -100°F dew point and at very low pneumatic pressures, minimizing noise and reducing compressor wear.

The air preparation system affects ozone production in grams per hour and more importantly ozone concentration, also known as “percent by weight.” Since ozone is produced with oxygen, the greater the percent of oxygen that enters the ozone generator will produce more grams per hour and concentration of ozone. Since the Ae Series ozone generation systems incorporate PSA oxygen concentrator they will yield the highest grams per hour at the highest concentrations. Greater ozone concentration equates to higher solubility of the ozone gas in solution, which will yield a greater oxidation potential.

Ozone Generator

A4e and A8e - Only:

The ClearWater Tech A4e is equipped with a CD10 ozone generator where as the A8e is equipped with CD12 ozone generator. The oxygen feed gas produced by the air preparation system is supplied to the ozone generator at a maximum pressure of 5 pounds per square inch (psi). It then flows into the built-in air flow meter; at this point, the feed gas is mostly drawn through the ozone generator by the vacuum created at the ozone injector - rather than by the pressure from the air preparation system compressors.

A15e - Only:

The A15e system is equipped with a ClearWater Tech CD1500P ozone generator designed to supply high concentrations of ozone gas (up to 10%) at 10 PSI. The oxygen feed gas produced by the air preparation system is supplied to the ozone generator, which flows through the built-in flow meter. A stainless steel needle valve, located on the front panel of the A15e, is used to maintain optimum pneumatic parameters inside the ozone reaction chamber. After this point the vacuum created at the ozone injector *draws* the ozone gas into the water line. The ozone generator is equipped with pressure switch, which prevents operation if pressure within the ozone reaction chambers drops below 9 PSI.

The feed gas of the Ae systems enters the fused, thermally-protected reaction chambers inside the ozone generator; some of the oxygen molecules are split while passing through the high voltage electrical field (the “corona”), forming single oxygen atoms (O₁). These oxygen atoms then recombine with other oxygen molecules in the air stream, forming ozone. Depending on the application, the Ae systems may be interlocked with an ORP controller, pressure switch, timer or circulation pump. Many safety features are also built in, including a vacuum or pressure switch, thermal protection and back flow prevention. The A15e also includes a remote shut down loop and depressurization-valve with internal off gas destruct (mounted inside the back compartment of the A15e) used to destroy this residual ozone with in the ozone generator, see Appendix - Section A.

Ozone Injection/Contacting

The ozone injector serves two purposes: One, it creates the vacuum required to safely draw the ozone gas from the ozone generator and two, it provides a means by which the ozone gas can become dissolved in water. A very dynamic injection process is required to effectively dissolve ozone in water.

ClearWater Tech injection systems use only Mazzei® injectors for maximum mass transfer efficiency. The injector produces a cavitation effect, enabling the ozone gas to join the water stream in the form of extremely tiny bubbles. These bubbles must be as small as possible in order to increase the ratio of bubble surface area to the amount of ozone entering the water.

Depending on the application and the water treatment goals, a Clear^W Some oxidation reactions take place so quickly that they are limited only by the rate at which the ozone is dissolved in the water. Other reactions, such as disinfection, may require that proper ozone residual be maintained for a specific amount of time. A correctly sized contact vessel is used for this purpose.

Ozone Destruct

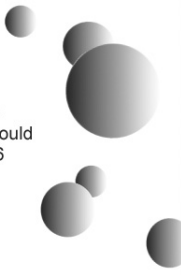
The ClearWater Tech off-gas destruct systems, consists of two components the ozone destruct unit (a heated chamber filled with manganese dioxide and copper oxide) and a water trap. Used in conjunction with a ClearWater Tech off gas vent, the ozone destruct system is an effective way to vent the contact vessel when it is impractical to send the off gas to atmosphere or reintroduce it to the water. See the “Ozone Off-Gas Destruct” manual for installation and maintenance procedures.

A Short Course in Fine Bubbles

LESSON 1 - The large bubble (20mm) has a volume of 4.19 cm³ and a surface area of 12.6 cm².

LESSON 2 - 296 small bubbles (3mm) could be made from the large bubble in lesson 1. They would have a total surface area of 83.6 cm². This is 6.6 times the surface area of the large bubble.

LESSON 3 - Theoretically, 6.6 times as much water could be ozonated with the same amount of ozone!



SAFETY WARNINGS

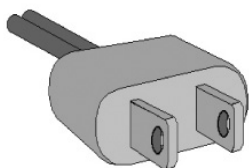
Two aspects of ClearWater Tech ozone generators represent potential dangers – ozone gas and high voltage electricity.

OZONE GAS - WARNING: HIGH CONCENTRATIONS OF OZONE GAS ARE DANGEROUS TO HUMANS. LOW CONCENTRATIONS CAN CAUSE IRRITATION TO THE EYES, THROAT AND RESPIRATORY SYSTEM.

The ClearWater Tech Ae corona discharge ozone systems are designed to operate under a vacuum or pressure condition. While safety precautions have been taken, entering the equipment area should be avoided if ozone gas is detected. Ozone has a very distinctive odor and is detectable at very low concentrations (0.02 ppm), which is far below OSHA's maximum permissible exposure level of 0.1 ppm.



HIGH VOLTAGE - WARNING: CLEARWATER TECH OZONE GENERATORS OPERATE AT HIGH VOLTAGE. DO NOT TAMPER WITH OR DELIBERATELY BYPASS THE COVER OR SAFETY SWITCHES BUILT INTO THE OZONE GENERATOR UNLESS INSTRUCTED TO DO SO BY THIS MANUAL. IF CONTACT IS MADE WITH OPERATING HIGH VOLTAGE COMPONENTS, ELECTRIC SHOCK WILL OCCUR.



ClearWater Tech Ae systems operate with line voltage. The incorporated corona discharge ozone generators take line voltage and convert it DC current. A high voltage transformer then boosts the voltage. While each ozone generator has a cover safety switch and other safety interlocks, proper care must be used by a qualified electrician when making any internal adjustments or performing any maintenance procedures.

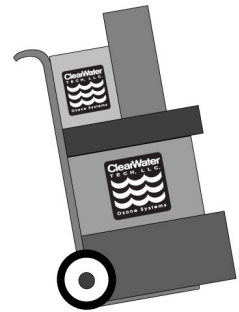
IMPORTANT SAFETY INSTRUCTIONS

When installing and using this electrical equipment, basic safety precautions should always be followed, including the following:

- 1. READ AND FOLLOW ALL INSTRUCTIONS.**
- 2. SAVE THESE INSTRUCTIONS.**
- 3. All electrical connections should be made by a licensed, qualified electrician.**
- 4. Before attempting any electrical connections, be sure all power is off at the main circuit breaker.**
- 5. Install all electrical equipment at least five feet from any open body of water using non-metallic plumbing.**
- 6. Install check valves to prevent water from contacting the electrical equipment.**
- 7. The electrical supply for this product must include a suitably rated switch or circuit breaker to open all ungrounded supply conductors to comply with Section 422-20 of the National Electrical Code, ANSI/NFPA 70-1987. The disconnecting means must be readily accessible to the operator(s) but installed at least five feet from any open body of water.**
- 8. Be sure to bond (ground) the system using the copper-bonding lug on the bottom front panel of the Ae system. The system should be bonded with solid copper wire conforming to all local, state and national electrical codes.**
- 9. The system should be sized appropriately for its intended use by a qualified professional familiar with the application. This equipment must be validated by the manufacturer for its intended use; failure to do so may void the warranty.**

Unpacking

Compare the ozone system equipment received to the packing list provided. Before beginning any installation procedures, thoroughly inspect all components for damage. If damage is noticed, promptly notify the freight carrier and request an on-site inspection. Inspect all packing materials for small parts before discarding. Inspect all plumbing, fittings and tubing for packing material that may have become lodged in openings.



Equipment Placement

- When placing the ozone system components on the equipment pad, make sure to consider safety, maintenance requirements, local building and fire codes, etc. The components should be easily accessible by the operators, including equipment access doors and electrical hook-up boxes. All meters, gauges, indicator lights and switches should be visible and accessible. Dimensional drawings of the Ae System are included in Section A of the Appendix.
- The Ae System should be located as close as possible to the point of ozone injection (within 20 feet is recommended). Ozone is an unstable gas and will begin reverting back to oxygen very quickly. To determine the most favorable ozone injection point, the following items should be considered:
 - Located *downstream* of all other existing water system components.
 - Located *upstream* of the residual sanitizer injection point (if so equipped).
 - Located *upstream* of the pH adjustment chemical injection point for a pool or spa recirculation applications or located *downstream* of pH adjustment chemical injection point for all single pass full flow applications.
 - Locate the pH adjustment chemical adjustment point *downstream* of the residual sanitizer injection point (if so equipped).
- Like any electronic component, performance and longevity is enhanced by favorable operating conditions. Also, since the air preparation system and ozone generator is air-cooled, a relatively dust-free, well-ventilated area is required. No caustic chemicals should be stored in the area surrounding the equipment. A minimum clearance of six inches from the vents on either side of the ozone generator is required.
- The equipment is heavy and requires proper support. Therefore, a clean, dry, level surface should be provided for the Ae system.
- The Ae systems are designed for specific voltage requirements and to withstand typical outdoor elements, though should *not* be subjected to outdoor extremes including contact internally with water and/or temperature extremes. Therefore, the equipment must be installed in an environment consistent with the following operating parameters:
 - Ambient temperature range: 20°F to 95°F continuous. If the temperature around the equipment consistently exceeds 95°F, additional air-cooling must be provided.
 - Humidity: 0 - 90% relative humidity, non-condensing environment.
 - Line voltage: +/-10% of rated input

Note: Equipment installed in extreme environmental conditions will void manufacturer's warranty.

- Allow room for the peripheral equipment (booster pump, injector manifold, contact vessel, etc.).



The ozone system should be plumbed using either a sidestream or full flow configuration. The sidestream method takes *a portion* of the water from the main flow (see Figure 4-1) and diverts it into a sidestream *downstream* of the filter (if so equipped). Ozone is introduced into the sidestream water and is allowed contact time with the water before it is returned to the main flow at a point *downstream* of all other equipment (heaters, solar panels, etc. if so equipped) in the circulation system. A booster pump is usually employed to compensate for the flow restriction caused by the sidestream loop and the injector manifold. If a halogen-type residual sanitizer is utilized, its injection point should be as far *downstream* as possible from the point at which the sidestream water returns to the main flow. In a full flow configuration, the same system components are usually involved and appear in the same order with respect to the direction of flow. However, all the water in the main flow is allowed contact time with the ozone (see Figure 4-2). A booster pump may be necessary to maintain proper flow requirements. If employed, the booster pump is located *upstream* of the point at which the ozone injector manifold is installed. Typical residential pool sidestream (see Figure 4-3) and full flow independent loop (see Figure 4-4) plumbing schematics have also been included in this chapter.

NOTES:

- Adequate use of unions and isolation valves is strongly recommended to facilitate maintenance and repairs.
- Use Schedule 80 PVC for all plumbing connections wherever possible. Plumbing size requirements are dictated by the water flow characteristics of the system.
- Make sure to use proper plumbing practices and secure all plumbing and system equipment according to local codes.
- Ozone is a powerful oxidizer and will degrade certain materials. Use ozone-compatible plumbing materials for section(s) of the system that will come in contact with ozone dissolved in water. The following is a list of materials that are compatible with ozone:
 - PVC
 - CPVC
 - Kynar
 - Teflon
 - Stainless Steel (300 series)
 - Viton
 - EPDM
 - Concrete
- Depending on the application, other components (psi gauge, flow meter, etc.) may be installed to assist in monitoring system parameters.

- Step 1:** Arrange the ozone system equipment (booster pump, injector and contact vessel) according to mechanical print or as dictated by equipment layout and serviceability considerations. Do not secure booster pump and contact vessel to housekeeping pads at this point. Dry fit plumbing as appropriate to insure proper fit and location before making permanent connections.
- Step 2:** Install a tee or plumbing saddle into the main water line after the filter (if so equipped) and before the flow diversion mechanism. The purpose of the mechanism is to restrict water flow so water is diverted into the sidestream (see Figure 4-1). If such a mechanism is not already present in the system (such as a heater bypass valve etc.), it will require installation – a valve (butterfly, gate or ball) or flow controller.
- Step 3:** Plumb a line from the tee or plumbing saddle to the booster pump. For serviceability of the equipment be sure to install an isolation valve between the tee or saddle and the booster pump.
- Step 4:** Plumb from the booster pump to the injector manifold. Make sure to note the correct direction of flow, indicated by a blue arrow on the inlet side of the manifold body. The check valve assembly is strapped to the manifold using wire ties. Remove the assembly, using Teflon® tape and install it onto the top opening of the injector.
- Step 5:** Plumb from the injector manifold to the inlet side of the contact vessel (if so equipped). To reduce possible backpressure to the injector, minimize the number of elbows between the injector manifold and contact vessel. The contact vessel is a specified size, determined by water flow requirements. A ClearWater Tech contact column and the 30, 40, 80, and 120-gallon contact tanks have inlet *and* outlet fittings on the bottom of the vessel and are designated with arrows showing the direction of flow. **Note: The inlet and outlet arrows on the contact tanks are under the base of the tank.**
- Step 6:** Using a tee or plumbing saddle, plumb from the outlet of the contact vessel back into the main water line. For serviceability of the equipment be sure to install an isolation valve between the outlet fitting on the contact vessel and before returning to the main water line.

Step 7: Secure the booster pump and contact vessel to solid mounting surfaces using appropriate hardware and according to local codes. If installing a ClearWater Tech contact column, use a ClearWater Tech contact column mounting kit and install according to the instructions below. If installing a contact tank, secure to a solid horizontal surface using mounting flange or feet

Step 8: Install the contact vessel venting system into the top of the vessel. If using the ClearWater Tech contact column, the vent kit supplied includes fittings, a control valve and Teflon® tubing. The contact tank venting system includes an air relief valve, fittings and a length of Teflon® tubing. Depending on conditions, the vented gas may be directed to an ozone destruct system, to atmosphere or to the low-pressure side of the water system.

Note: Do not direct the tubing to the suction side of any pump in the system.

Contact Column Installation (if so equipped)

Step 1: Make sure the following hardware items are included in the contact column mounting kit:

- 'L' bracket
- 1/2" concrete anchors
- 6" clamp assembly
- Unistrut bar
- Protective end cap
- Mounting hardware

Step 2: Referring to Figure 4-5, mark the two holes for mounting the 'L' bracket to the wall. The bracket should be located so that the 6" clamp assembly will be approximately 12" from the top of the contact column. Drill a 1/2" hole at each of the marks, about 3 1/2" deep. Insert a concrete anchor into each hole with the threaded end facing outward. Slip the 'L' bracket over the threaded ends of the anchors, followed by a washer for each anchor. Secure the bracket to the wall by threading a nut onto each anchor and tightening.

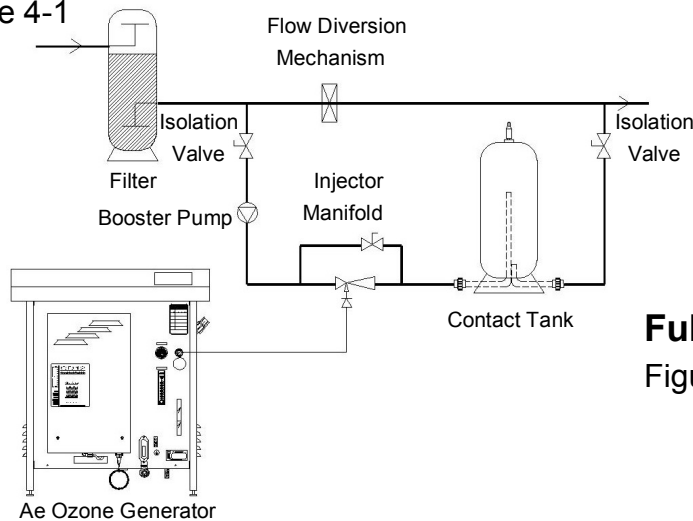
Step 3: Cut the unistrut bar to the desired length and attach it to the 'L' bracket using hardware provided.

Step 4: Slip the two sides of the 6" clamp into the unistrut bar and then around the contact column. Tighten the retaining bolt, securing the contact column to the unistrut bar.

Step 5: Slip the protective end cap over the exposed end of the unistrut bar.

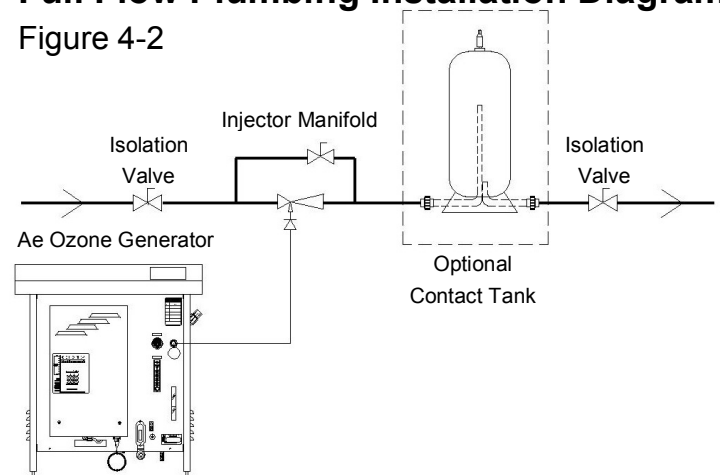
Sidestream Loop Plumbing Installation Diagram

Figure 4-1



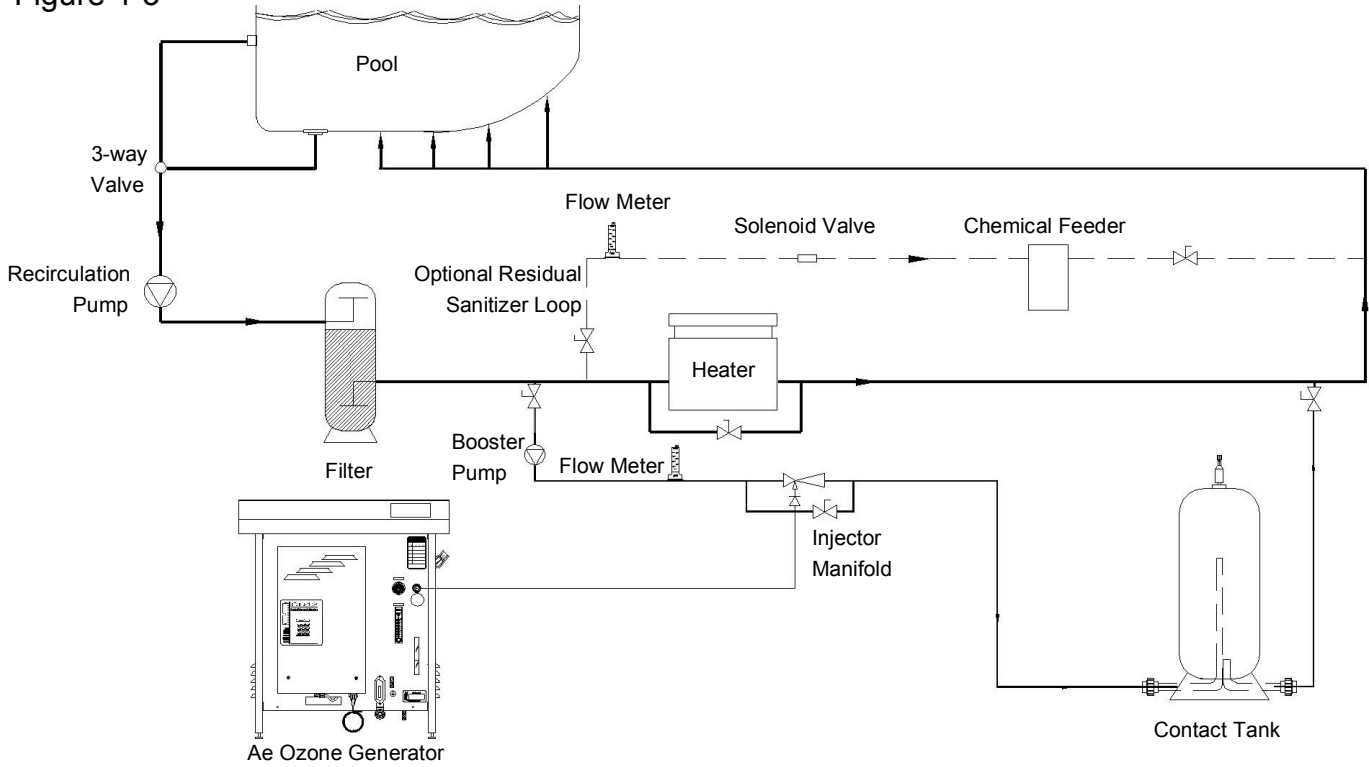
Full Flow Plumbing Installation Diagram

Figure 4-2



Residential Pool - Sidestream Loop Plumbing Installation Diagram

Figure 4-3



Residential Pool - Independent Loop Plumbing Installation Diagram

Figure 4-4

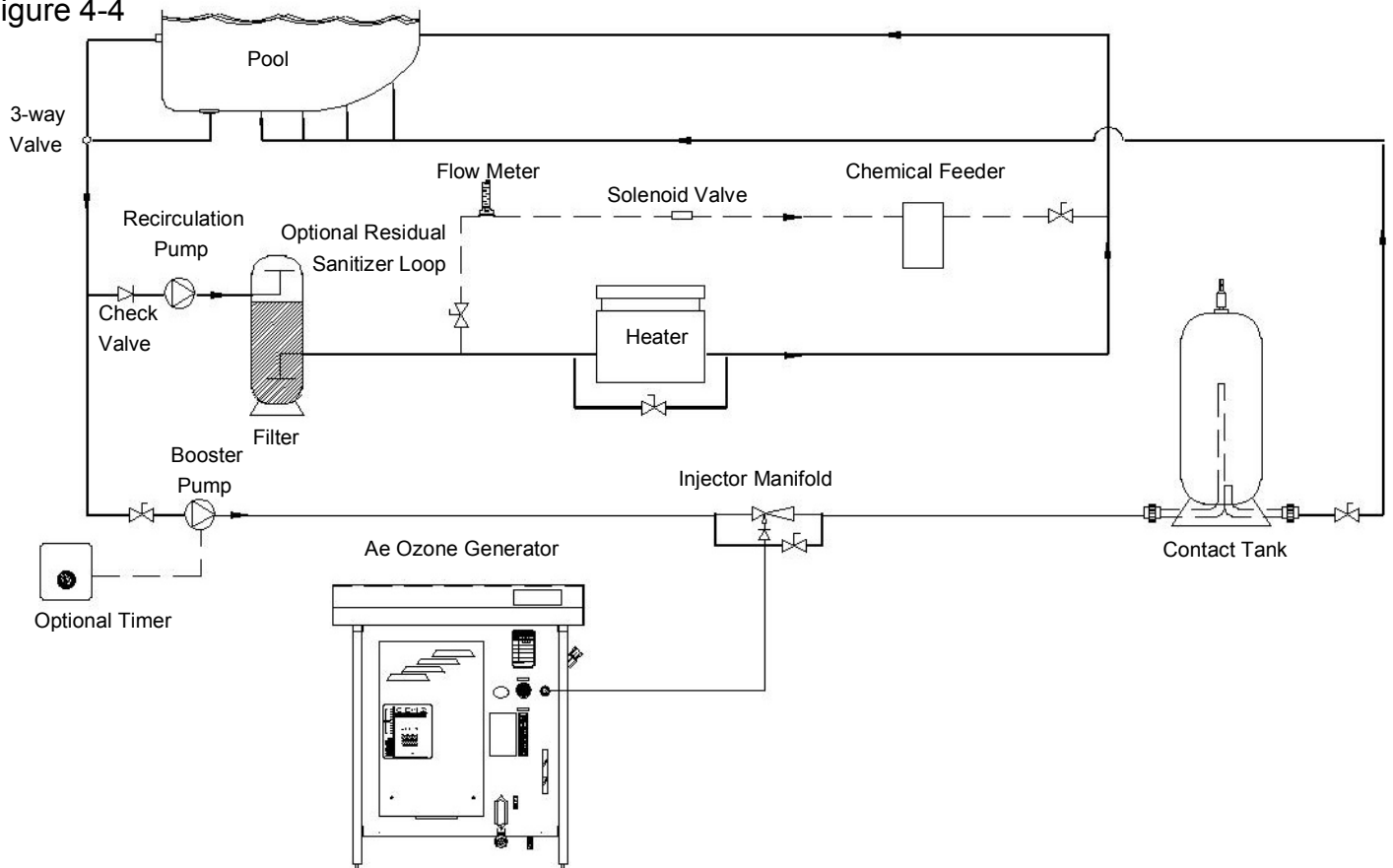


Figure 4-5

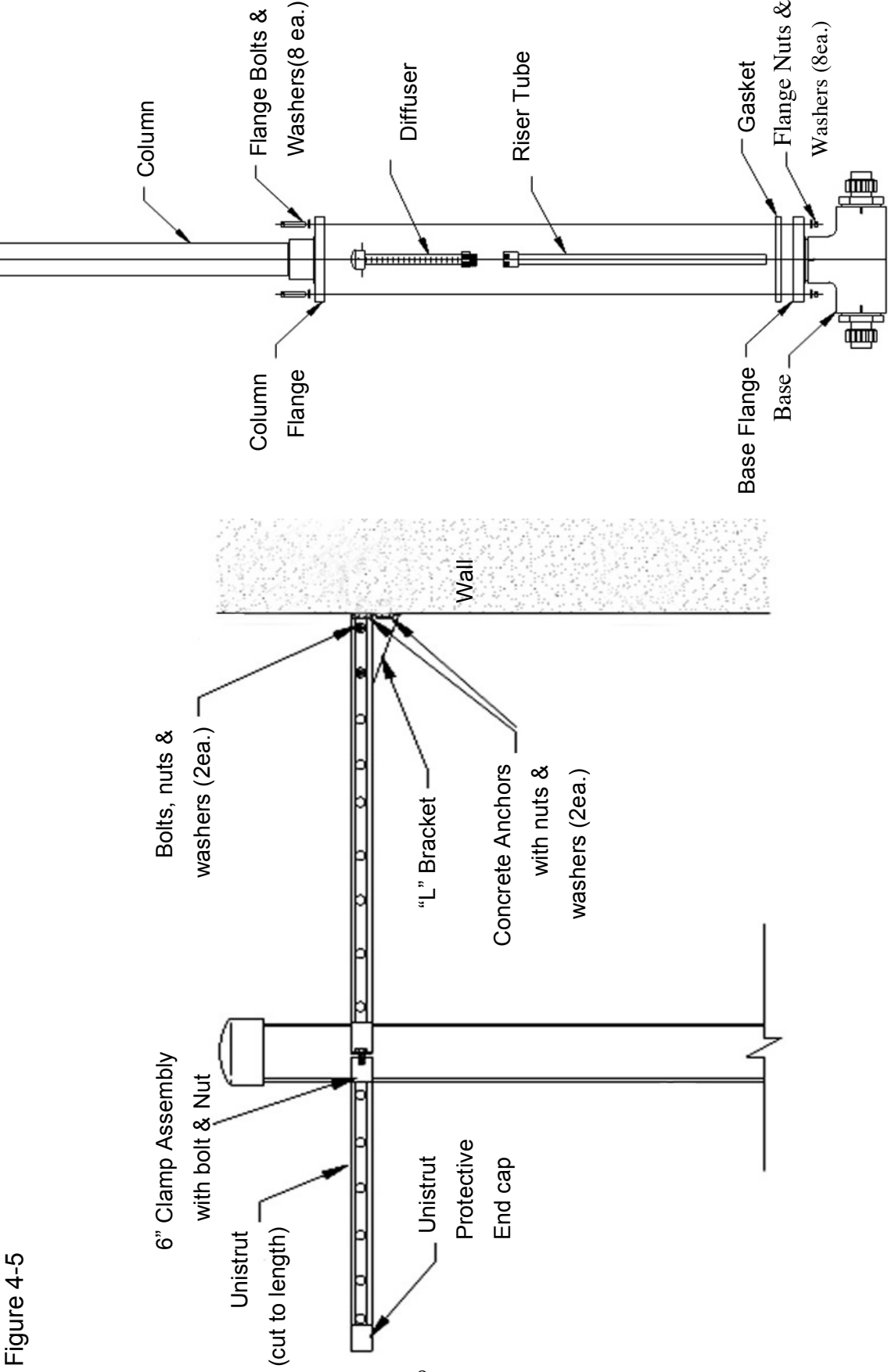


Figure 4-6

Contact Column Exploded View



The Ae Series ozone generation systems are designed to hard wire to the main power source with specific input voltage requirements. All possible pre-wiring has been

completed at the factory. Logic schematics have been provided in the Appendix - Section D.

NOTES:

- All electrical connections should be made by a licensed, qualified electrician. All local, state and national codes must be observed.

- Make sure all power is off at the main circuit breaker before making any electrical connections.

Step 1: Conforming to all local, state and national electrical codes, ground the Ae system to a true earth ground. Use solid copper bonding wire (usually #8 AWG) from the copper-bonding lug located on the bottom of the ozone generator to the grounding point.

Step 2: Main Power – Wire the Ae system from the conduit at the bottom of the system to the main power source with specified input voltage, either 120VAC 60Hz (L1-Black and Neutral-White) or 220VAC 50Hz (L1-Black and L2/Neutral-Red), single phase (1 ϕ), +/- 10% of rated voltage.

Step 3: Ozone Output Control – The Ae Series ozone generators are equipped with two options for controlling the ozone output, either a manual 0-100% ozone output control or a remote 4-20mA control input signal. See Appendix-Section A for location.

Ae Series Power Consumption		
Input Voltage	120VAC 60Hz	220VAC 50Hz
A4e	6.5 amps	3.2amps
A8e	6.9 amps	3.5 amps
A15e	7.5 amps	3.8 amps

- 1. Manual Ozone Output Control** - Turning the control knob counterclockwise will decrease the ozone output down to 0%, while turning the knob clockwise will increase the ozone output up to 100%. The “Ozone Output” is indicated by the LED(s) on the front of the ozone generator, see Appendix - Section A.
- 2. Remote 4-20mA Control:** The ozone generator will automatically sense the 4-20mA input signal and override the setting of the manual ozone output control. Based on the 4-20mA signal, ozone output will increase or decrease, 4mA = 0% ozone output, 20mA = 100% ozone output. The “Ozone Output” is indicated by the LED(s) on the front of the ozone generator, see Appendix - Section A. **Note: If the remote 4-20mA signal fails or is missing, the system will default to the manual ozone output setting. Check and adjust the manual ozone output control knob to avoid over-ozonation.** Following the directions in the manual of the 4-20mA control device, wire the negative (-) input signal to the Purple wire of the ozone generator and the positive (+) input signal to the Orange wire of the ozone generator.

Step 4: The Ae Series systems are designed with an interlock shut down device. The A4e and A8e are equipped with an internal Vacuum Switch and the A15e is equipped with a Remote Shut Down Loop. These two devices will shut down the Ae system completely when in a Normally-Open (N.O.) state.

- 1. Vacuum Switch:** The A4e and A8e are equipped with an internal vacuum switch. The Ae system will remain powered down until the system is energized with main power and the system senses a minimum of -3 inches of mercury (in.Hg.) or vacuum from the injection manifold.
- 2. Remote Shutdown Loop:** The A15e is equipped with a blue #18 AWG energized normally-closed control circuit, used to shut down the ozone system in an emergency. In all cases, this loop must remain closed for the ozone system to operate. It may be used with any continuity-type switch, such as an ozone off-gas detector. The loop can be found separated with two wire-nuts attached in the conduit at the bottom-front panel of the A15e (where the main power leads are located). **Notes: Whether the loop is interfaced with a device or simply connected together to create continuity for normal operation, the loop should be disconnected or an “OPEN” circuit until otherwise mentioned in the procedures outlined in Chapter 7 “Start-up and Calibration Procedures.” Failure to do so may result in ozone escaping to atmosphere.**

This section outlines the steps required to complete the ozone system pneumatic hook-ups. The system components include the air preparation system, ozone generator, vacuum break and ozone injector manifold

(see Figure 6-1). The ozone gas is drawn from the ozone generator and through the vacuum break by the suction created at the ozone injector manifold.

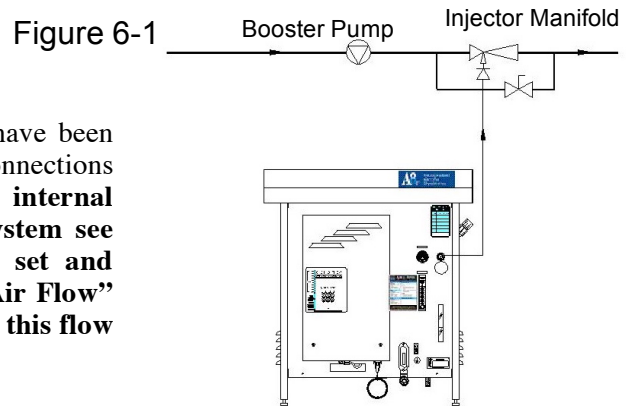


Figure 6-1

Shown: ClearWater Tech A8e Ozone Generation System

Ae series air preparation system

• **Air Preparation System** – All possible pneumatic connections have been made to the Ae system at the factory, there are no internal connections required. **Note:** The A15e ozone system is equipped with an internal SCFH flow meter located in the back compartment of the system see Appendix-Section A for location. This flow meter is factory set and should not require field adjustment, see the “Air Preparation Air Flow” line of the Pneumatic Operating Parameter Chart, Figure 7-2. If this flow meter requires adjustment follow the steps below.

Step 1: Remove back cover of the A15e.

Step 2: Disconnect the compression nut and tubing from top fitting of the SCFH flow meter.

Step 3: Apply main power to system. Oxygen will begin to flow through the flow meter. **Note:** The Remote Shutdown Loop must be “CLOSED” or have continuity.

Step 4: Set the flow meter to 6 SCFH.

Step 5: Disconnect main power from the system. **Note:** Disconnect or “OPEN” the Remote Shut Down Loop connection, so that it does not have continuity.

Step 6: Connect the compression nut and tubing to the top fitting of the SCFH meter and replace back cover.

Note: When the system is in normal operation the SCFH flow meter setting may drop due to backpressure through the system. Do not re-adjust the flow meter.

Vacuum break-to-injector manifold

The Ae Systems incorporate an internal vacuum break (see Figure 6-2), which provides a positive atmospheric “break” between the ozone injector manifold and the Ae system, preventing water from flowing back into the ozone generator should the venturi check valve fail. If the check valve at the venturi begins to leak or fails completely, vacuum is interrupted and water will flow toward the ozone generator. With the incorporated vacuum break the water will flow down the riser tube (away from the ozone generator) and out to drain, protecting the Ae system from potential water damage. All pneumatic connections have been made between the ozone generator of the Ae system and the internal vacuum break. The only pneumatic field connections required are between the vacuum break ozone outlet fitting and the injector manifold. Follow the steps outlined below for this procedure.

Step 1: Remove the Fill Port Cap located on the Fill Port and fill the Riser Tube with clean water (no particulate matter) to the middle of the Vacuum Break Fill Window, see Appendix-Section A.

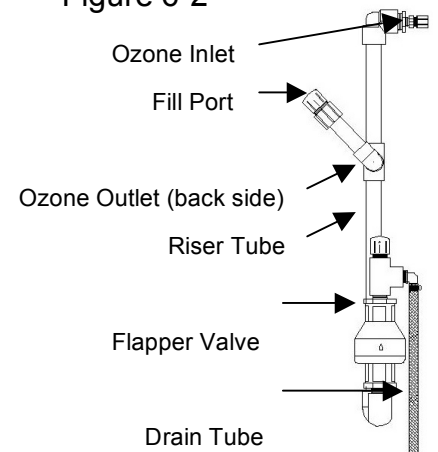
Step 2: Re-install the Fill Port Cap, hand tight. **Note:** Do not over tighten as damage to PVC fittings may occur.

Step 3: Connect one end of a suitable length of Teflon® delivery line to the vacuum breaks’ ozone outlet port see Appendix-Section A. The other end of the Teflon® delivery line will be attached to the fitting threaded into the top of the check valve assembly, do not attach until directed in Chapter 7 “Start-up and Calibration Procedures”.

Step 4: Adjustments to the by-pass valve on the ozone injector manifold will be necessary. These steps are covered in Chapter 7 “Start-up and Calibration Procedures.”

Vacuum Break Detail

Figure 6-2



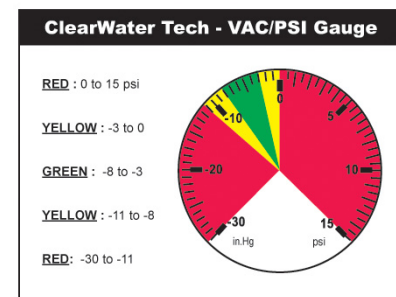
The previous sections of this manual have involved comparatively static procedures – making electrical and pneumatic connections, fitting pipe, etc. This section involves the dynamic process of starting up and balancing the components of the ozone system, including initiating water flow, making air and water flow adjustments, etc.



Maximum performance and reliability is achieved when the prescribed air flow is maintained at the A4e or A8e ozone system while the system is operating under a slight vacuum (measured in inches of mercury, or “in.Hg”), where as the A15e system is operating under pressure (PSI). The air from the air preparation system in the A4e and A8e is flowing toward the ozone generator under pressure, and from the ozone generator under vacuum (created by the ozone injector manifold). The change from pressure to vacuum occurs at the SCFH meter and vacuum gauge located on the front panel of the A4e and A8e. Where as, the air from the air preparation system of the A15e is flowing *through* the ozone generator under pressure, and *from* the ozone generator under a slight vacuum (created by the ozone injector manifold). The change from pressure to vacuum occurs after the stainless steel ozone outlet needle valve located on the front panel of the A15e.

Ae Ozone Generation System and Injection Manifold

- Step 1:** Make sure all isolation valves in the ozone water system are open (Figures 4-1 or 4-2 show recommended isolation valve locations).
- Step 2:** Start-up hydraulics. Allow the water in the system to reach hydraulic equilibrium (contact vessel full, off-gas vent operating, etc.) and observe for plumbing leaks. **Notes: Water flow must be established through the main water pump and the ozone system booster pump (if so equipped).**
- Step 3:** Close the ball valve on the injector manifold about half way, if not already done so.
- Step 4:** Make sure main power is available to the Ae system and peripheral equipment. **Note: The A15e Remote Shut-down Loop should be “OPEN” at this time (so that the A15e will not energize). The ozone delivery line from the either of the Ae systems should not be attached to the injection manifold check valve assembly.**
- Step 5:** Using your thumb, check for the presence of vacuum (suction) at the ozone injection manifold check valve assembly or use a ClearWater Tech SCFH/Vacuum Test Assembly to check vacuum at the injector port. If no suction is present, continue to close the ball valve on the injector manifold until vacuum is detected. If using the vacuum test assembly, check the VAC/PSI gauge for vacuum. If the needle is in the red zone on the pressure (PSI) side of the gauge, gradually close the ball valve on the injector manifold until the needle moves into the green zone. If the needle is in the red zone on the vacuum (in.Hg) side of the gauge, gradually open the ball valve on the injector manifold until the needle moves into the green zone. While vacuum is in the green zone, proper SCFH (Standard Cubic Feet per Hour) of air flow must be achieved, see “Pneumatic Operating Parameters”, Figure 7-2.
- Step 6:** Attach the Teflon® ozone delivery line of the Ae system to the compression fitting threaded into the check valve assembly, mounted to the injector manifold.
- Step 7:** **A15e – only:** Connect the two ends of the A15e Remote Shutdown Loop together or to an interface device to create continuity or a “CLOSED” circuit. As soon as continuity is present the A15e will be energized, however ozone will not be produced until the PSI gauge on the front panel of the system is set to 10 PSI.
- Step 8:** **A4e and A8e – only:** Using the ball valve on the ozone injector manifold and the SCFH air flow adjustment valve on the A4e and A8e (front panel) make final adjustments to vacuum and air flow levels, see “Pneumatic Operating Parameters,” Figure 7-2.
- A15e – only:** Using the stainless steel needle valve located at the front panel of the A15e system (see Appendix-Section A), adjust the backpressure of the ozone reaction chambers to 10 PSI. Check the PSI gauge on the front panel of the ozone generator, which measures this backpressure. If there is insufficient backpressure the needle valve may be closed slightly; similarly, if there is too much backpressure the valve may be opened slightly. **Note: The lock nut on the needle valve must be loosened prior to adjustment and tightened after adjustment.** Due to the pressure switch installed, the PSI gauge must achieve a minimum of 9 PSI before ozone will begin production.



Start-Up and Calibration (continued)

The CFH gauge on the front cover of the A15e ozone generator will monitor the CFH air flow rate. By setting the oxygen concentrator SCFH (completed in the “Air Preparation” section of “Installation Procedures – Pneumatic”) and ozone generator backpressure PSI, there will be no adjustments of CFH air flow. See “Air prep system air flow” specifications outlined in Figure 7-2.

Step 9: Perform a final check of all pneumatic connections from the air preparation system to the ozone injector manifold. Repair leaks as required. Check all system water connections, including the ozone injector manifold, vacuum break and contact vessel. Repair leaks as required. **Note: The check valve at the ozone injector manifold may make a humming noise. This is normal.**

Step 10: Observe indicating LED(s), on the front cover of the Ae systems ozone generator and adjust the manual ozone output knob to desired level setting. See Figure 7-1 A-C and Appendix-Section A for proper function and location.

A4e and A8e - Ozone Generator LED Function

Figure 7-1 A

LED	Function	CD10	CD12
OZONE OUTPUT	The ten LED's represent 0-100%, minimum to maximum ozone output. Each LED is equal to 10% output. These LED's can be adjusted with the manual output control knob located at the bottom of the ozone generator or automatically with a remote 4-20mA control signal.		
POWER	Main Power is 'ON' to the ozone generator, when LED is illuminated.		
HV DRIVE	Power is being sent to the high voltage drive board, when the LED is illuminated.		
EXT LOOP	The External Loop has continuity through it when the LED is <i>not</i> illuminated, which indicates ozone is being produced. The External Loop <i>does not</i> have continuity, when the LED is illuminated, which indicates no ozone production.		
HIGH TEMP	The High Temp LED will not be illuminated during normal operation. If the ozone generator's internal temperature is in excess of 150°F the High Temp LED will illuminate, which will discontinue ozone production.		

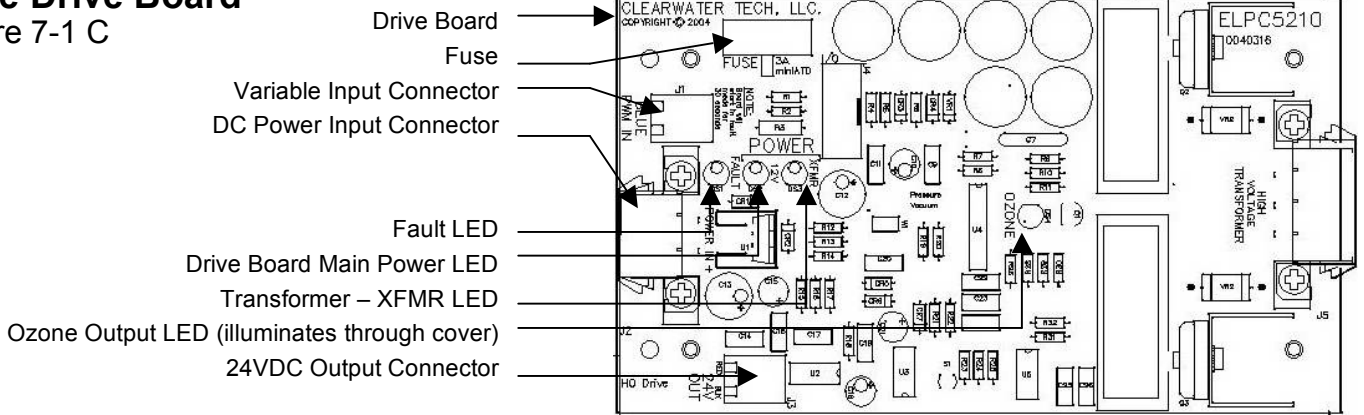
A15e - Ozone Generator Drive Board LED Function

Figure 7-1 B

LED	Function
12V MAIN POWER	When illuminated, this “Green” LED indicates that main power is supplied to the drive module up to the “on board” fuse of the drive board.
XFMR POWER	When illuminated, this “Green” LED indicates that 48V Buss power is available to the drive module transformer (XFMR) from the “on board” fuse to the drive transformer.
OZONE OUTPUT	The “Amber” ozone output LED will illuminate when ozone is being generated. The LED will also pulse as the output increases or decreases with either the Manual Ozone Output Control located on the bottom of the ozone generator (see Appendix, Section A), or from a Remote 4-20mA signal (see “Installation Procedures – Electrical”).
FAULT	When illuminated, this “Red” LED indicates that there is a fault with the drive module or the Ozone Reaction Chamber. If this LED is illuminated, refer to the Troubleshooting Guide. Notes: Upon startup, the fault LED will remain illuminated for 30 seconds before ozone is produced. If the drive module goes to a fault condition, the drive board will restart every 30 seconds. If the fault is not remedied the drive module will continue to go into a fault mode. When the drive module is in fault mode ozone will not be generated.

A15e Drive Board

Figure 7-1 C



Vacuum Break

Check the water level in the vacuum break, making sure it is *above* the flapper valve (see Figure 6-2). If water is not pressing downward on the flapper valve, it will open, causing a loss of vacuum. A loss of vacuum means ozone cannot be drawn through the vacuum break, which in turn can cause an ozone leak, see Troubleshooting Guide.

Pneumatic Operating Parameters

Figure 7-2

A4e	Operating Range	Optimum
Ozone generator air flow	3 to 4 scfh	4 scfh
Vacuum gauge	-3 to -8 in.Hg.	-5 in.Hg.
Injector manifold air flow	3 to 4 scfh	4 scfh
SCFH @ Venturi	-3 to -8 in. Hg.	-5 in. Hg.

A8e	Operating Range	Optimum
Ozone generator air flow	6 to 8 scfh	8 scfh
Vacuum gauge	-3 to -8 in.Hg.	-5 in.Hg.
Injector manifold air flow	6 to 8 scfh	8 scfh
SCFH @ Venturi	-3 to -8 in. Hg.	-5 in. Hg.

A15e	Operating Range	Optimum
Air preparation air flow (flow meter – back side of system*)	5 to 6 scfh	6 scfh
Ozone generator air flow (flow meter – front cover)	2 to 6 cfh	3 cfh
PSI gauge (gauge – front cover)	9 to 12 psi	10 psi
Injector manifold air flow	4 to 6 scfh	6 scfh
SCFH @ Venturi	-3 to -8 in. Hg.	-5 in. Hg.

* - This flow meter is set at atmospheric pressure. See, "Installation Procedures – Pneumatic - Air Preparation" section. The flow rate will be reduced when in normal operation and should read similar to the ozone generator air flow meter.

Maintenance of the ozone system is critical to its longevity and operating efficiency. While all system components are built to provide years of reliable service with minimum maintenance, following the procedures outlined below is strongly recommended.



All maintenance procedures have been segmented by interval – daily, monthly, semi-annual and annual. Daily procedures involve quick, visual checks for changes in normal operating conditions. Monthly, semi-annual and annual procedures include cleaning and/or replacement of certain critical parts.

NOTES:

- **The ozone generator warranty states that it “does not extend to any product or part which has been damaged or rendered defective as a result of use of parts not sold by ClearWater Tech, or service or unit modification not authorized by ClearWater Tech.” Please contact your ClearWater Tech dealer if you have any questions about any maintenance procedure *before* you begin that procedure.**
- **CAUTION: Observe all common safety practices and review the “Safety Warnings and Instructions” (Chapter 2) before attempting any maintenance procedure that requires the use of tools and/or shutting down the ozone system.**

Daily Procedures

Ozone Generator:

- **Indicating Lights - A4e and A8e Only:** Check the indicator lights on the ozone generator. See Figure 7-1A for Ozone Generator LED Display function.
- **Indicating Lights - A15e Only:** Check for illumination of the drive module "Ozone Output" LED (for LED location, see Appendix Section A). If the Ozone Output LED is not illuminated, *observe* the complete operating function of the drive module LED's. Before checking drive module LED function (see A15e Drive Board, Figure 7-1B-C for LED location and function), remove the ozone generator cover and depress the cover safety switch located on the ozone generator chassis (see Appendix-Section A). **CAUTION: Depressing overrides the cover safety switch. The ozone generator will remain energized with the cover removed. Do not touch anything inside the ozone generator while this switch is activated! Please consult your ClearWater Tech dealer before attempting this procedure.**
- **Air Flow:** Check the SCFH or CFH gauge on the front panel of the Ae system. Make sure air flow is within the range shown on the “Ozone generator air flow” line of the “Pneumatic Operating Parameters” (see Figure 7-2). Adjust if necessary by following the steps out lined in the “Start-Up & Calibration” section.
- **Vacuum - A4e and A8e Only:** Check the vacuum gauge located on the A4e and A8e front panel. Make sure vacuum is within the range shown on the “Vacuum Gauge” line of the “Pneumatic Operating Parameters” chart (see Figure 7-2). Adjust if necessary by following the steps out lined in the “Start-Up & Calibration” section.
- **Pressure - A15e Only:** Check the pressure gauge located on the A15e ozone generator. Make sure pressure is within the range shown on the “PSI Gauge” line of the “Pneumatic Operating Parameters” chart (see Figure 7-2).

Vacuum Break:

- **Water Level:** check the Vacuum Break Fill Window. Fill as required by removing the threaded cap on top of the fill port and fill water into the fill port until water is visible to the middle of the Vacuum Break Fill Window, (see Figure 6-2 and Appendix-Section A).

Injection Manifold:

- **Check Valve:** Inspect the Teflon® ozone delivery line that runs between the vacuum break and the check valve assembly on the suction port of the ozone injector manifold. If water is observed in the delivery line near the check valve assembly, the check valve has failed. See Troubleshooting Guide.

Monthly Procedures

Air Preparation System:

- **Cooling Fan Operation -** Place a hand over the back compartment cover's right-hand louver, positive air flow should be detected. If air flow is not detected remove back cover of the Ae system and check for cooling fan (see Appendix-Section A for location) operation. If not, refer to the Troubleshooting Guide.
- **Air Flow - A15e only:** Check the SCFH flow meter mounted inside the back compartment (see Appendix-Section A for location) to be sure the SCFH is within then range shown on the “Air Preparation Air Flow” line of the

“Pneumatic Operating Parameters” chart (see Figure 7-2). To adjust, see ‘Installation Procedures – Pneumatic’ section.

Ozone Generator:

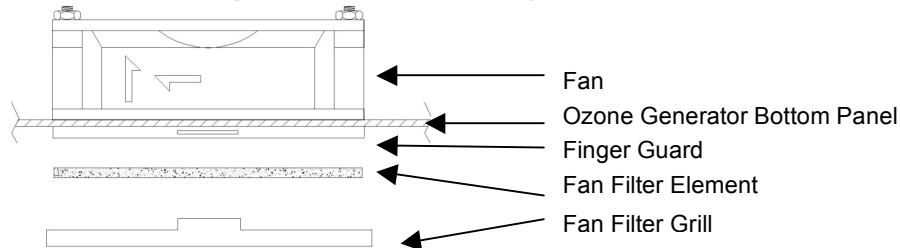
- Cooling Fan Operation – check to make sure the cooling fan (mounted on the bottom panel of the ozone generator) is operating. If not, refer to the Troubleshooting Guide.
- Cooling Fan Filters – Check the cooling fan filter element (mounted on the fan assembly located at the bottom panel of the ozone generator) and clean as required. Operating conditions in the equipment area will dictate the frequency required for this procedure. Remove the filter element and clean with soap and water, drying them completely before re-installing, (see Figure 8-1).

Booster Pump(s):

- Strainer Baskets - Check and clean the strainer basket in the booster pump as required (if so equipped).

Ozone Generator Cooling Fan Assembly

Figure 8-1



System Shutdown Procedures

CAUTION: The ozone generator operates at high voltages. Follow these steps carefully before performing any semi-annual or annual maintenance procedures.

Step 1: Turn off power to any peripheral system hydraulic components.

Step 2: Turn the main power service disconnect or breaker to the “OFF” position of the Ae System. The LED’s on the front cover should *not* be illuminated.

Step 3: Check main power with a multi-meter to be sure all power is disconnected.

Semi-Annual Procedures

CAUTION: Follow system shutdown procedures before performing any of the following steps.

Air Preparation System:

- Air Inlet Filter - Replace the air compressor inlet filter (see, Appendix-Section A). **Note: Manufacturers' recommended replacement interval is 4,000 hours of operation. Operating conditions in the equipment area will dictate the required frequency of this procedure.**

Annual Procedures

CAUTION: Follow system shutdown procedures before performing any of the following steps.

Air Preparation System:

- Compressor - Following the procedures outlined in the compressor rebuild kit; rebuild the two compressor heads. **Note: Manufacturers' recommended interval is 5,000 to 12,000 hours of operation. Compressor performance and/or operating conditions in the equipment area will dictate the required frequency of this procedure.**

Ozone Generator:

- Cooling Fan Filters – Clean or replace the cooling fan filter element as required. **Note: Operating conditions in the equipment area will dictate the required frequency of this procedure.**
- Inline Particulate Filter – Replace the inline particulate filter.
- Reaction Chambers – Remove and disassemble the reaction chamber according to the steps outlined below (A4e and A8e see Figure 8-2. A15e see Figure 8-3). Check the chamber interior and dielectric tube for oil, dirt or moisture. **Note: Disassembly and service of the reaction chamber(s) is a technical, delicate and critical procedure. Please consult your ClearWater Tech dealer before attempting this procedure.**

Reaction Chamber Removal and Disassembly A4e and A8e - only:

Step 1: Make sure all power to the ozone generator has been disconnected according to the “System Shutdown Procedures” outlined above.

Step 2: Disconnect the high voltage lead(s) and tubing connections from both ends of the reaction chamber(s).

- Step 3:** Remove reaction chamber from ozone generator.
- Step 4:** Remove retaining screws and washers from the two end caps (3 each).
- Step 5:** Using a gentle back-and-forth twisting motion, remove the non-high voltage end cap (the one *without* the high voltage attachment screw) from the heat sink/cathode assembly. **Note: Orientation of the end cap on the heat sink/cathode assembly.**
- Step 6:** Remove the high voltage end cap and dielectric from the heat sink/cathode assembly. **Note: Orientation of the end cap on the heat sink/cathode assembly.** Remove end cap and contact brush from dielectric glass anode.
- Step 7:** With contact brush attached, remove the brush adapter nut from the high voltage end cap.
- Step 8:** Inspect the dielectric, end caps and cathode for breakage, corrosion or debris. Clean and/or replace parts as necessary. Re-assemble the reaction chamber per the instructions below.

Reaction Chamber Removal and Disassembly A15e – only:

- Step 1:** Make sure all power to the ozone generator has been disconnected according to the “System Shutdown Procedures” outlined above.
- Step 2:** Unplug the electrical connections from the drive board.
- Step 3:** Remove the 4-20mA control board with mounting bracket from the reaction chamber.
- Step 4:** Disconnect tubing connections from the fittings on both ends of the reaction chamber.
- Step 5:** Disconnect the high voltage lead from the drive module.
- Step 6:** Remove reaction chamber from ozone generator.
- Step 7:** Remove retaining screws from the two end caps (4 each).
- Step 8:** Using a gentle back-and-forth twisting motion, remove the non-high voltage end cap (the one *without* the white power lead attached) from the heat sink/cathode assembly. **Notes: Orientation of the end cap on the heat sink/cathode assembly. The stainless steel clamp must not be removed.**
- Step 9:** Remove the high voltage end cap and dielectric from the heat sink/cathode assembly. **Notes: Orientation of the end cap on the heat sink/cathode assembly. The stainless steel clamp must not be removed.**
- Step 10:** With contact brush attached, remove the brush adapter nut from the high voltage end cap.
- Step 11:** Inspect the dielectric, end caps and cathode for breakage, corrosion or debris. Clean and/or replace parts as necessary. Re-assemble the reaction chamber per the instructions below.

Reaction Chamber Assembly and Re-installation A4e and A8e - only:

- Step 1:** Make sure the glass dielectric is clean (free of dust, dirt, grease, oils, etc.).
- Step 2:** Prepare the end caps for re-assembly by replacing the O-rings. Thread the hex brush adapter nut, with contact brush attached, onto the end of the high voltage end cap (cap with the high voltage attachment screw) center screw.
- Step 3:** Using a gentle twisting motion, press the *non*-high voltage end cap onto the heat sink/cathode assembly until flush with the heat sink cooling fins. **Note: Correct orientation of end cap on the heat sink/cathode assembly.**
- Step 4:** Slide the three end cap retaining screws with washers through the holes in the non-high voltage end cap, aligning them with the heat sink screw bosses. Thread screws into screw bosses until heads are snug against the end cap.
- Step 5:** Slide the dielectric into the heat sink/cathode assembly. Seat the dielectric into the O-rings of the non-high voltage end cap by applying pressure with a gentle twisting motion. (There must not be any dirt, debris, oils or fingerprints on the dielectric upon re-installation).
- Step 6:** *Slowly* insert the high voltage end cap assembly into the dielectric. **Note: Do not bend center wire of the brush during this procedure.** It is normal for the *bristles* to bend flat against the dielectric glass. Using a gentle twisting motion, press the high voltage end cap onto the heat sink/cathode assembly until flush with the heat sink cooling fins. **Note: Orientation of the end cap on the heat sink/cathode assembly.**
- Step 7:** Slide the three end cap retaining screws with washers through the holes in the end cap, aligning them with the heat sink screw bosses. Thread screws into screw bosses until heads are snug against the end cap.
- Step 8:** Re-install complete reaction chamber assembly into the ozone generator, reconnect the high voltage lead(s) and tubing connections to both end caps. Follow steps outlined in Chapter 7 - “Start-Up and Calibration” to re-start the ozone system.

Assembly and Re-installation A15e – only:

- Step 1:** Make sure the glass dielectric is clean (free of dust, dirt, grease, oils, etc.).
- Step 2:** Prepare the end caps for re-assembly by replacing the O-rings. Thread the hex brush adapter nut, with contact brush attached, onto the end of the high voltage end cap (cap with the white power lead attached) center screw.
- Step 3:** Using a gentle twisting motion, press the *non*-high voltage end cap onto the heat sink/cathode assembly until flush with the heat sink cooling fins. **Note: Orientation of the end cap on the heat sink/cathode assembly.**

Maintenance (continued)

- Step 4:** Slide the four end cap retaining screws through the holes in the non-high voltage end cap, aligning them with the heat sink screw bosses. Thread screws into screw bosses until heads are snug against the end cap.
- Step 5:** Roll the high voltage anode (foil-like material) lengthwise, preserving the *longer* dimension. Insert the rolled anode into the dielectric. Center the anode in the dielectric (approximately 1/2" from either end of the glass), making sure it is rolled squarely.
- Step 6:** Slide the dielectric into the heat sink/cathode assembly. Seat the dielectric into the O-rings of the non-high voltage end cap by applying pressure with a gentle twisting motion. (There must not be any dirt, debris, oils or fingerprints on the dielectric upon re-installation).
- Step 7:** *Slowly* insert the high voltage end cap assembly into the dielectric. **Note: Do not bend center wire of the brush during this procedure.** It is normal for the *bristles* to bend. Using a gentle twisting motion, press the high voltage end cap onto the heat sink/cathode assembly until flush with the heat sink cooling fins. **Note: Orientation of the end cap on the heat sink/cathode assembly.**
- Step 8:** Slide the four end cap retaining screws through the holes in the end cap, aligning them with the heat sink screw bosses. Thread screws into screw bosses until heads are snug against the end cap.
- Step 9:** Re-install complete reaction chamber assembly into the ozone generator by following the "Removal and Disassembly" instructions in reverse order, from Step 6 to Step 2. Follow steps outlined in Chapter 7, "Start-Up and Calibration," to re-start the ozone system.

Depressurization Valve – Internal Destruct:

- **A15e Only** – Rebuild depressurization solenoid valve. Remove ozone destruct mounted to the top of the valve, and follow the rebuild instructions supplied with solenoid valve rebuild kit.

Vacuum Break:

- Cleaning – Remove the vacuum break fill port cap and flush vacuum break with water to remove any debris that may have accumulated. As required disassemble vacuum break and clean the seat of the flapper valve with a soft cloth. Re-assemble vacuum break and fill water into the fill port until water is visible to the middle of the Vacuum Break Fill Window, (see Figure 6-2 and Appendix-Section A).

Injector Manifold:

- Check Valve – Replace the check valve located at the ozone injection manifold. **Note: Because the system is in the shutdown mode, no vacuum is present at the injector. Therefore, it is normal for some water to be flowing from the injector during this procedure.**

Contact Vessel:

- Cleaning – Contact Column only: Inspect the diffuser slots at the top of the contact column riser tube. If they are clear, no further maintenance is required. If the slots are fouled, disassemble the column and clean as required, following the steps outlined below (see Figure 4-6).

Step 1: Make sure the isolation valves before and after the contact column are closed.

Step 2: Disconnect the vent line from the top of the contact column.

Step 3: Remove the bolts in the 6" base flange.

Step 4: Remove the column, lifting it over the interior riser tube.

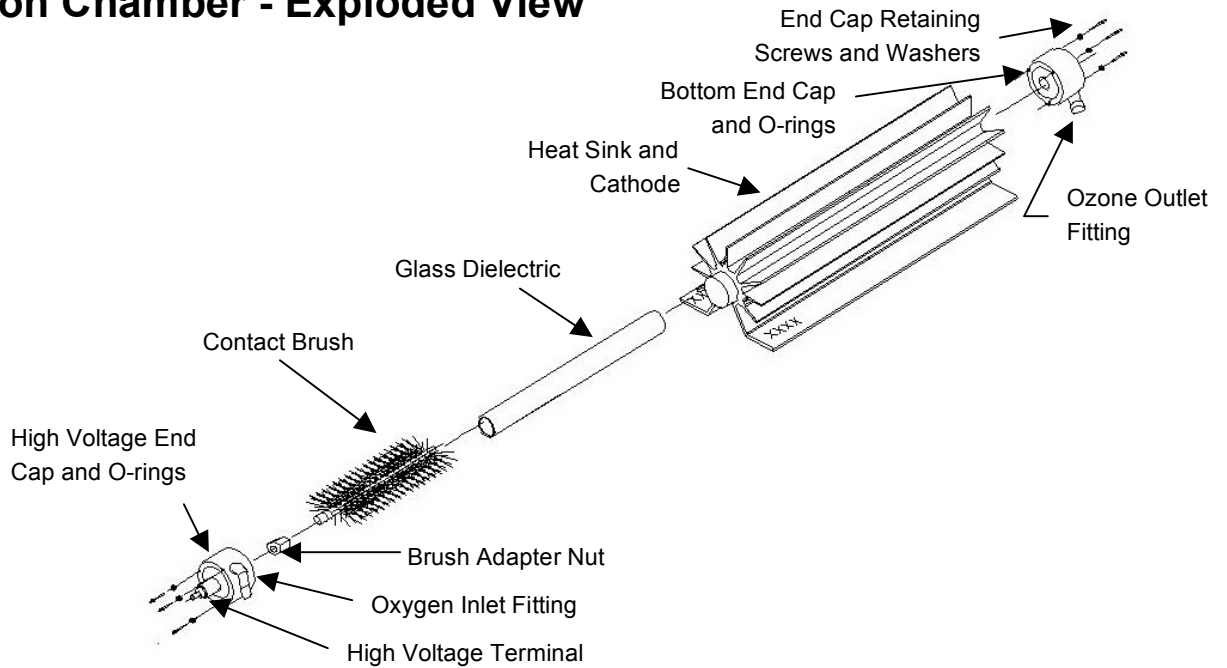
Step 5: Remove and clean the diffuser.

Step 6: Inspect the flange gasket and replace if necessary.

Step 7: Reassemble the contact column and attach vent lines.

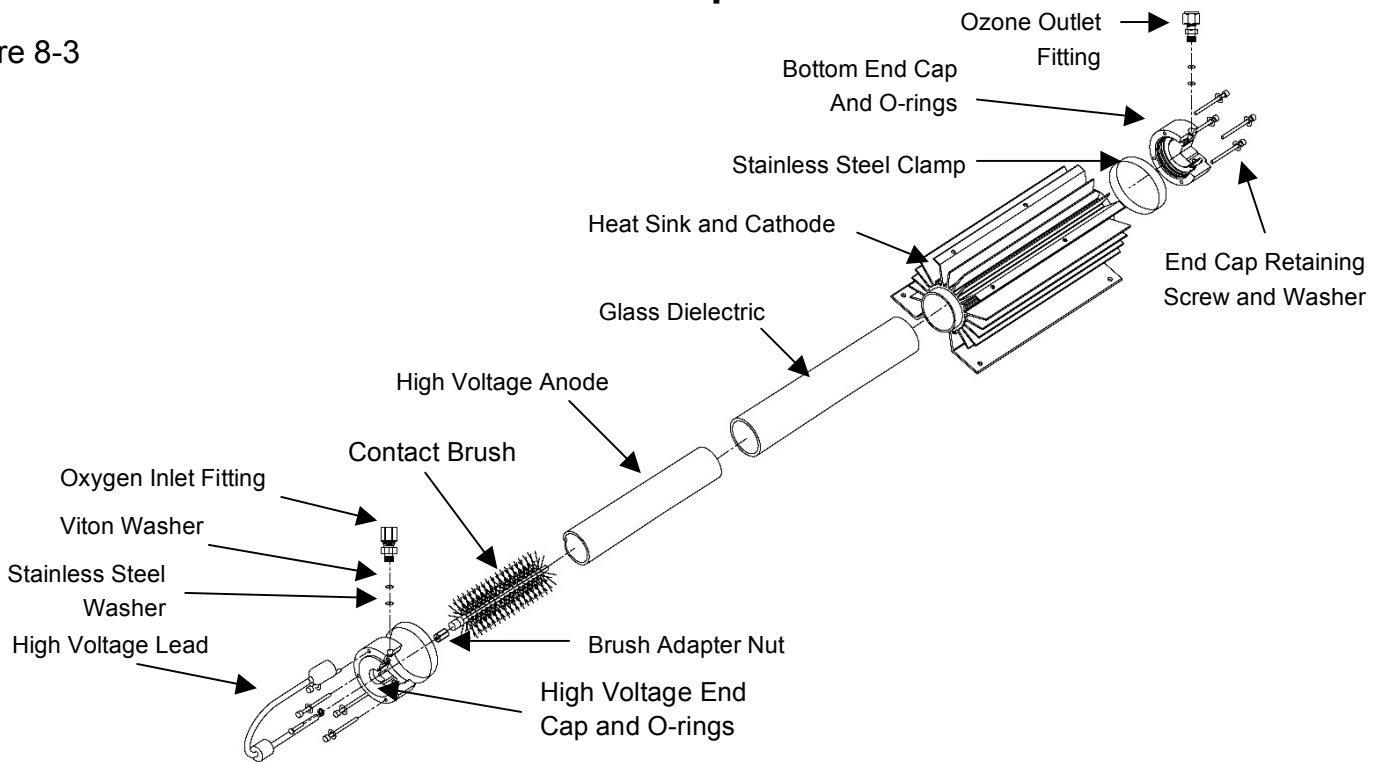
1" Reaction Chamber - Exploded View

Figure 8-2



2" Pressurized Reaction Chamber - Exploded View

Figure 8-3



AIR PREPARATION

PROBLEM/SYMPTOM	POSSIBLE CAUSE	SOLUTION
Compressor not operating	<ul style="list-style-type: none"> - No power to Ae System - Insufficient vacuum through system, A4e and A8e - Remote Shutdown Loop of A15e does not have continuity - Incorrect wiring 	<ul style="list-style-type: none"> - Check main power to system - Adjust injector manifold by-pass See 'Start-Up & Calibration' - Check loop or device used, see 'Installation Procedures' - Electrical - See 'Installation Procedures'- Electrical
Low air flow or no air flow (front panel of A4e and A8e, front cover of A15e ozone generator)	<ul style="list-style-type: none"> - Flow meter out of adjustment - Fouled compressor inlet filter - Compressor not functioning - Air leak 	<ul style="list-style-type: none"> - Adjust flow meter A4e and A8e See 'Start-Up & Calibration' - Adjust SCFH flow meter A15e back compartment - Replace inlet filter - Rebuild or replace as required - Check & tighten fittings
Compressor pressure relief valve making noise	<ul style="list-style-type: none"> - Excessive backpressure in system - Pinched tubing - Compressor not functioning - Sieve bed (ATF) not functioning 	<ul style="list-style-type: none"> - Inspect check valves for proper operation and replace as required. - Replace tubing - Rebuild or replace as required - Replace as required
Fan not operating (back compartment)	<ul style="list-style-type: none"> - Debris caught in fan - Fan inoperable 	<ul style="list-style-type: none"> - Remove debris - Replace fan

OZONE GENERATOR – A4e and A8e

PROBLEM/SYMPTOM	POSSIBLE CAUSE	SOLUTION
LED display is not illuminated	<ul style="list-style-type: none"> - No power to Ae System - Insufficient vacuum to ozone generator - Ozone generator main power switch is in the "OFF" position - Blown fuse(s) - Incorrect wiring - LED display board ribbon cable is disconnected from the output control board 	<ul style="list-style-type: none"> - Check main power to system - Adjust injection manifold See 'Start-Up & Calibration' - Turn switch to the "ON" position - Replace fuse(s) - See 'Installation Procedures' –Electrical - Connect ribbon cable (be sure all of the pins are properly inserted into the output control board)
'Main Power' LED is not illuminated, but all other LED's are illuminated	<ul style="list-style-type: none"> - LED display board is inoperable 	<ul style="list-style-type: none"> - Replace LED display board
Circuit breaker trips	<ul style="list-style-type: none"> - Incorrect wiring to Ae System - Circuit breaker amperage does not match system draw - Unit flooded with water 	<ul style="list-style-type: none"> - See 'Installation Procedures' - Electrical - Replace with correct circuit breaker - Assess damage, correct cause and rebuild as required
'HV Drive' LED is not illuminated	<ul style="list-style-type: none"> - No power to the high voltage drive board 	<ul style="list-style-type: none"> - Check board to be sure it is attached securely to the mother board - Bad high voltage drive board, replace as required

OZONE GENERATOR – A4e and A8e - continued

PROBLEM/SYMPTOM	POSSIBLE CAUSE	SOLUTION
'EXT Loop' LED is illuminated	- The external loop does not have continuity	- See Figure 7-1A for function
'Ozone Output' LED's are not illuminated	- The manual ozone output potentiometer is set to 0% output - Remote 4-20mA controller is sending a 4mA signal, which limits output 0%	- See 'Installation Procedures' - Electrical - No solution required, controller will adjust LED's automatically
Ozone Output LED's are not responding to the remote 4-20mA control signal	- The remote 4-20mA control signal is not sensed by the 4-20mA control circuit	- Check for loose wires or connections - See 'Installation Procedures' - Electrical - Check 4-20mA controller operation
'Hi Temp' LED illuminated	- Unit is overheating	- Check fan for proper operation and clean fan filter - Check ambient operating temperature - See 'Installation Procedures' - Getting Started...Equipment Placement'
Internal Mother Board 'Power' LED not illuminated	- No power to system - Blown main power fuse - Blown mother board fuse - Inoperable mother board	- See 'Installation Procedures' - Electrical - Replaces fuse - Replace fuse - Replace mother board
Receive an electrical shock upon touching the unit	- Incorrect wiring - Unit not grounded - Unit flooded with water	- See 'Installation Procedures' - Electrical - Ground unit according to local codes - Assess damage, correct cause and rebuild as required
Fan not operating	- Debris caught in fan - Fan inoperable	- Remove debris - Replace fan
Low vacuum	- Hydraulics/Pneumatics out of adjustment - Defective check valve - No water in vacuum break - Off-gas vent restricted - Defective O-ring seals in reaction chamber(s) - Loose internal fittings - Defective dielectrics	- See 'Start-Up & Calibration' - Backwash filter (if so equipped), - Replace check valve - Fill vacuum break with water – see 'Start-Up and Calibration' - Clean Off-gas vent - Check and replace as required - Check all fittings, tighten as required - Check and replace as required
High Vacuum	- Hydraulics/Pneumatics out of adjustment - Change in hydraulics - excessive water flow through ozone injector	- See 'Start-Up & Calibration' - See 'Start-Up & Calibration'
Unit flooded with water	- Defective check valve - Vacuum break flapper valve stuck - Hydraulics out of adjustment	- Assess damage, repair as required, replace check valve - See 'Maintenance Procedures' - Annual - See 'Start-Up & Calibration'
Ozone smell detected from or near ozone generator	- Insufficient vacuum at venturi - Loose internal fittings - Defective O-ring seals in reaction chamber(s) - Defective dielectrics	- See 'Start-up & Calibration' - Check all fittings, tighten as required - Check and replace as required - Check and replace as required

OZONE GENERATOR – A15e

PROBLEM/SYMPTOM	POSSIBLE CAUSE	SOLUTION
“Main Power” light is not illuminated or System is not “ON” (Located under CD1500P)	<ul style="list-style-type: none"> - No power to Ae System - Remote Shutdown Loop of A15e does not have continuity - Switch is in the “OFF” position - Blown fuse 	<ul style="list-style-type: none"> - Check main power to system - Check loop or device used, see 'Installation Procedures' - Electrical - Turn switch to the “ON” position - Replace fuse
Circuit breaker trips	<ul style="list-style-type: none"> - Incorrect wiring - Incorrect wiring - Circuit breaker amperage does not match system draw - Unit flooded with water 	<ul style="list-style-type: none"> - See 'Installation Procedures' - Electrical - See “Installation Procedures” - Electrical - Replace with correct circuit breaker - Assess damage, correct cause and rebuild as required
Receive an electrical shock upon touching the unit	<ul style="list-style-type: none"> - Incorrect wiring - Unit not grounded - Unit flooded with water 	<ul style="list-style-type: none"> - See ‘Installation Procedures’ – Electrical - Ground unit according to local codes - Assess damage, correct cause and rebuild as required
Drive Module - Main Power “Green” LED not illuminated	<ul style="list-style-type: none"> - No power to drive module from power supply 	<ul style="list-style-type: none"> - Check main power to unit - Test voltage from power supply to drive module (see 'Appendix' – Drive Board Input Voltages) - Check for loose wires or connectors
Transformer (XFMR) Power, “Green” LED not illuminated	<ul style="list-style-type: none"> - If drive board “Main Power” LED is not illuminated, the “XFMR Power” LED will not illuminate - Blown drive board “on board” fuse - Drive board is in “Fault” mode 	<ul style="list-style-type: none"> - Test voltage from power supply to drive module (see “Appendix–Drive Board Input Voltages”) - Replace “on board” fuse - See Troubleshooting, “Fault” LED
Ozone Output, “Amber” LED not illuminated	<ul style="list-style-type: none"> - If the Transformer (XFMR) Power LED is not illuminated, the “Ozone Output” LED will not illuminate - The Manual Ozone Output potentiometer is turned down to 0% - Remote 4-20mA Controller is sending a 4mA signal, which limits output to 0% - Drive board is in “Fault” mode 	<ul style="list-style-type: none"> - Check all wires and connectors - See ‘Installation Procedures’ - Electrical - No solution required, controller will adjust LED automatically - See Troubleshooting, “Fault” LED
The “Ozone Output” LED not responding to the remote	<ul style="list-style-type: none"> - The remote 4-20mA control signal is not sensed by the 4-20mA control board 	<ul style="list-style-type: none"> - Check for loose wires or connections - See ‘Installation Procedures’ – Electrical - Check 4-20mA controller operation
Fault, “Red” LED illuminated	<ul style="list-style-type: none"> - Upon start-up the “Fault” LED will be “ON” for 30 seconds, this is normal - Loose wire harness connection from the drive board to the drive transformer - Failed drive board - Failed drive transformer - Broken dielectric - Water in ozone reaction chamber - Excessive dirt or debris in the ozone reaction chamber - Loose or disconnected High Voltage lead to transformer - High temp Limit 	<ul style="list-style-type: none"> - Wait for the start-up to finish - Check all wires and connectors - Replace drive board - Replace drive transformer - Replace dielectric - Clean dielectric and replace O-rings - Clean dielectric and replace O-rings - Tighten or Attach High Voltage lead to transformer - See “Troubleshooting” - High Temp Limit

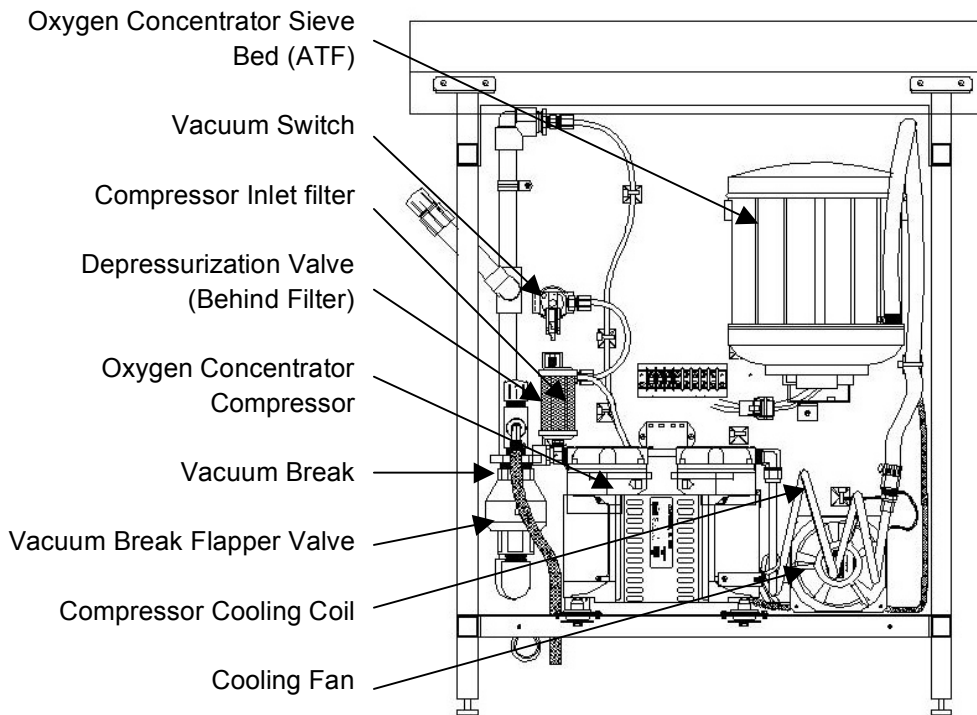
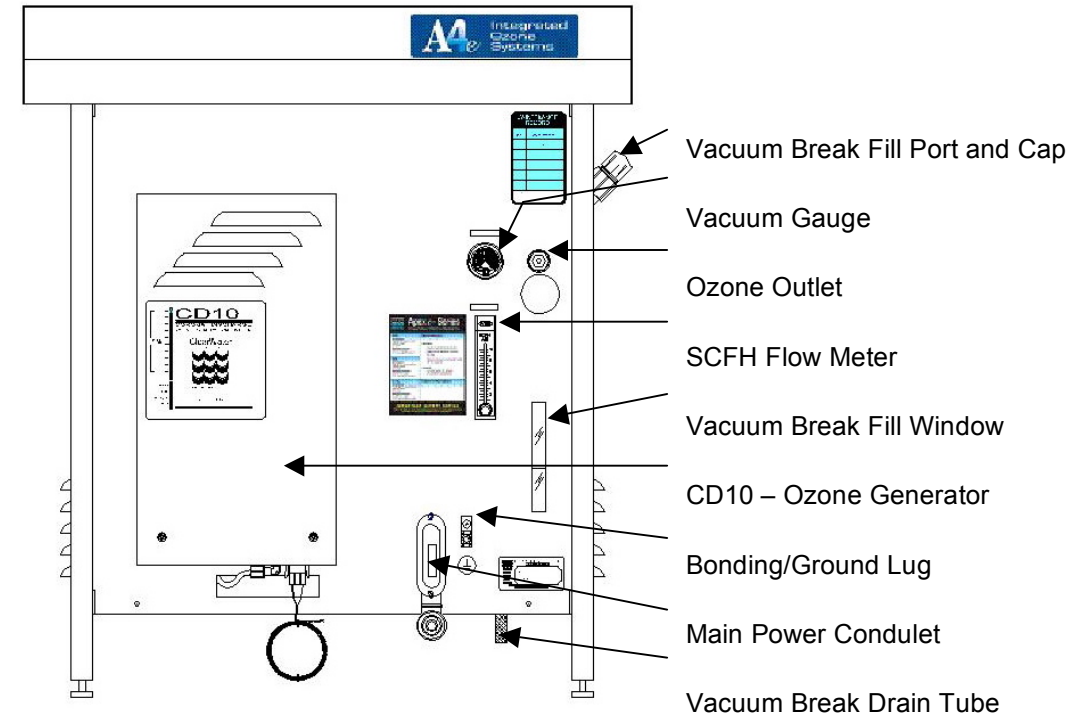
OZONE GENERATOR – A15e - continued

PROBLEM/SYMPOM	POSSIBLE CAUSE	SOLUTION
High Temp Limit	- Unit is over heating	- Check fan for proper operation and clean fan filter - Check operating temperature - See “Installation Procedures–Getting Started...Equipment Placement”
Fan not operating	- Fan obstructed - Power supplies not operating - Fan inoperable	- Remove obstruction - Check main power, check fuses. Repair or replace as required - Replace fan
Low vacuum	- Hydraulics out of adjustment - Defective check valve - No water in vacuum break - Off-gas vent restricted - Loose fittings	- See 'Start-Up & Calibration' - Backwash filter (if so equipped) - Replace check valve - Fill vacuum break with water – See ‘Start-Up and Calibration’ - Clean off-gas vent - Check all fittings, tighten as required
High Vacuum	- Hydraulics out of adjustment - Change in hydraulics - excessive water flow through ozone injector	- See 'Start-Up & Calibration' - See 'Start-Up & Calibration'
Low air flow or no air flow	- Air prep system not operating - Fouled inline filter - Air leak	- See Troubleshooting – Air Preparation - Change inline filter - Check all fittings, tighten as needed
Unit flooded with water	- Defective check valve - Vacuum break flapper valve stuck - Hydraulics out of adjustment	- Assess damage, repair as required, Replace check valve - See ‘Maintenance Procedure’ – Annual - See 'Start-Up & Calibration'
Ozone smell detected from or near ozone generator	- Insufficient vacuum at venturi - Loose internal fittings - Defective O-ring seals in reaction chamber - Defective dielectrics	- See 'Start-Up & Calibration' - Check all fittings, tighten as required - Check & replace as required - Check & replace as required

OZONE INJECTION/CONTACTING

PROBLEM/SYMPOM	POSSIBLE CAUSE	SOLUTION
Water backflow past injector check valve	- Defective check valve	- Replace check valve
Water bubbling in vacuum break	- Insufficient vacuum at venturi - Debris on seat of vacuum break flapper valve	- See 'Start-Up & Calibration' - See 'Maintenance Procedures' – Annual
No vacuum at venturi inlet port	- Ozone injector out of adjustment - Low water flow through ozone injector - Back pressure in hydraulic line - Booster pump not functioning properly	- See 'Start-Up & Calibration' - Check for obstructions upstream of ozone injector - Check for obstructions downstream of ozone injector - Check booster pump (contact dealer)
Ozone smell detected around vacuum break or ozone injector	- Insufficient vacuum at venturi - Loose fittings	- See 'Start-Up & Calibration' - Check all, tighten as required

Specifications

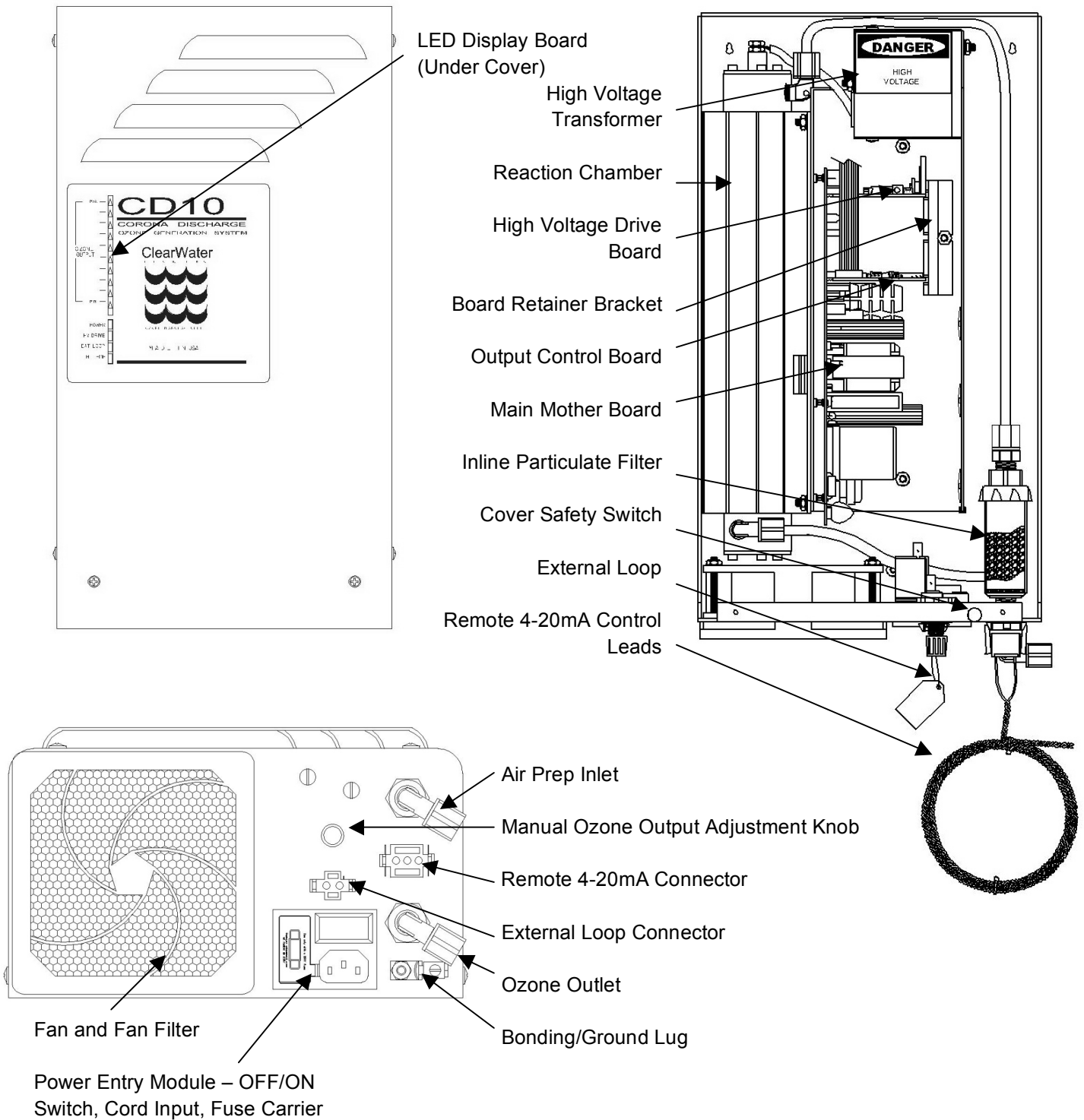


Shown: ClearWater Tech A4e Ozone Generation System (Wire harness omitted for clarity)

OZONE SYSTEM	SPECIFICATIONS	OZONE OUTPUT/SCFH
A4e	32.5 +1.0/-0.5 h x 28" w x 22" d, 45 lbs	4g/h, 3% @ 4 scfh

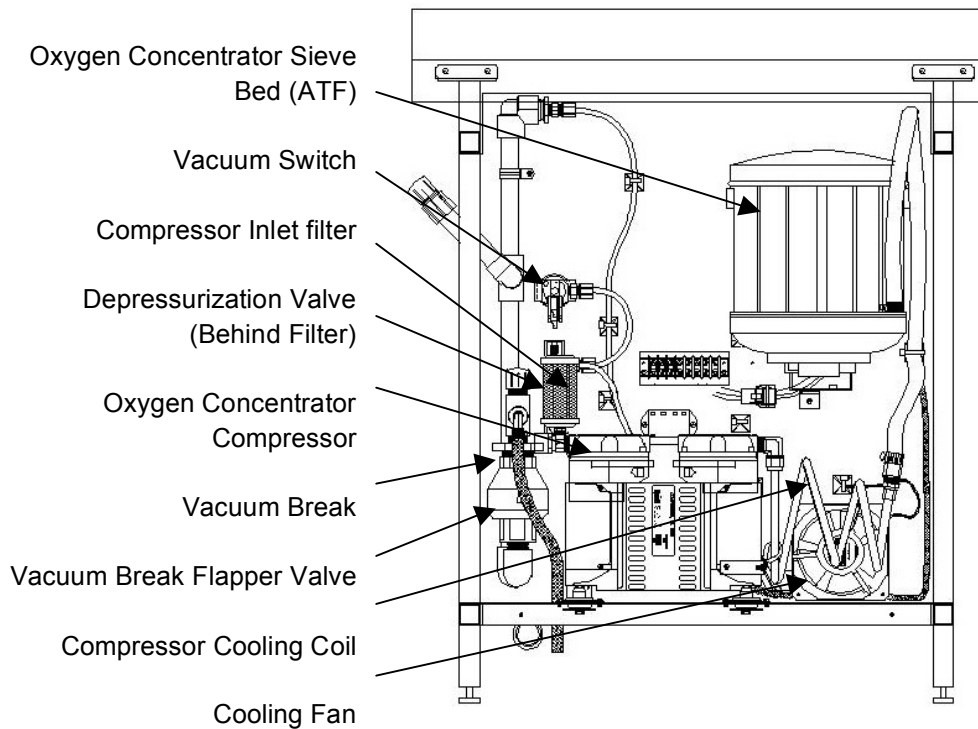
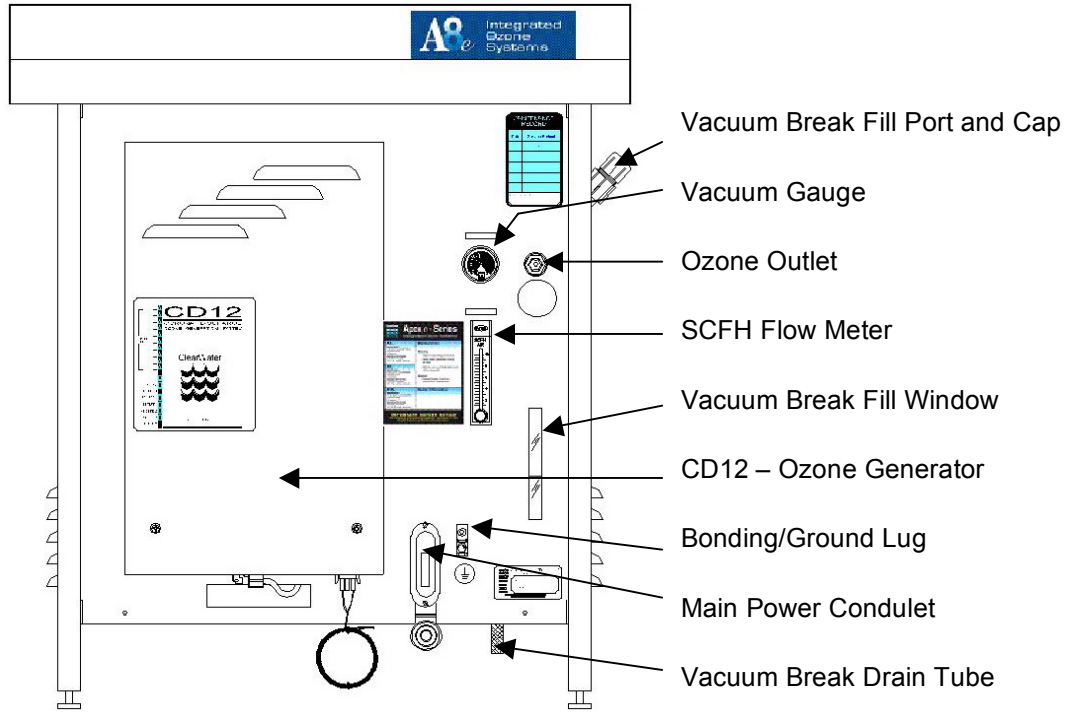
Section A – Specifications

A4e – Ozone Generator



Shown: ClearWater Tech CD10 Ozone Generator (Wire harness omitted for clarity)

Section A – Specifications

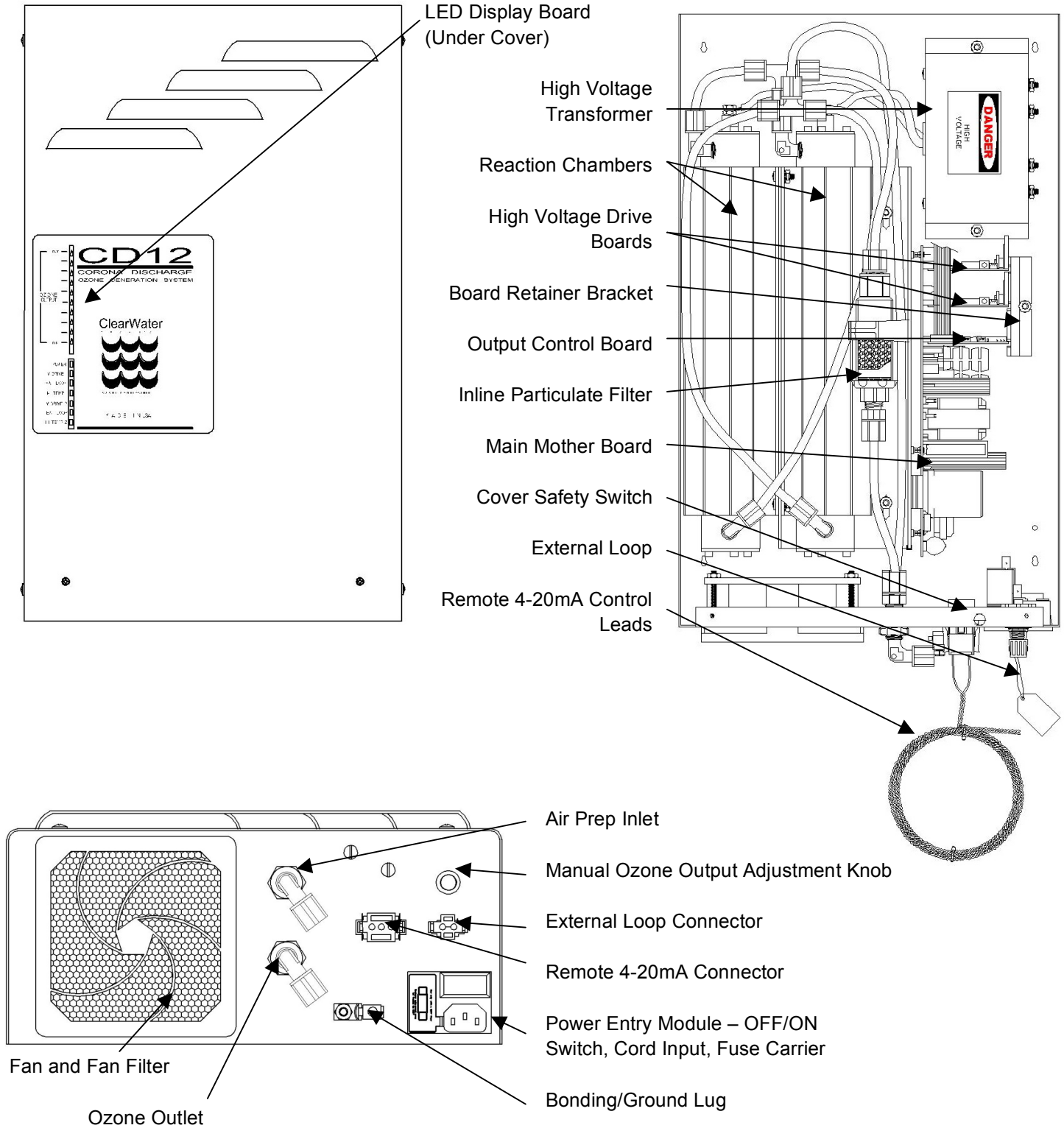


Shown: ClearWater Tech A8e Ozone Generation System (Wire harness omitted for clarity)

OZONE SYSTEM	SPECIFICATIONS	OZONE OUTPUT/SCFH
A8e	32.5 +1.0/-0.5 h x 28" w x 22" d, 45 lbs	8g/h, 3% @ 8 scfh

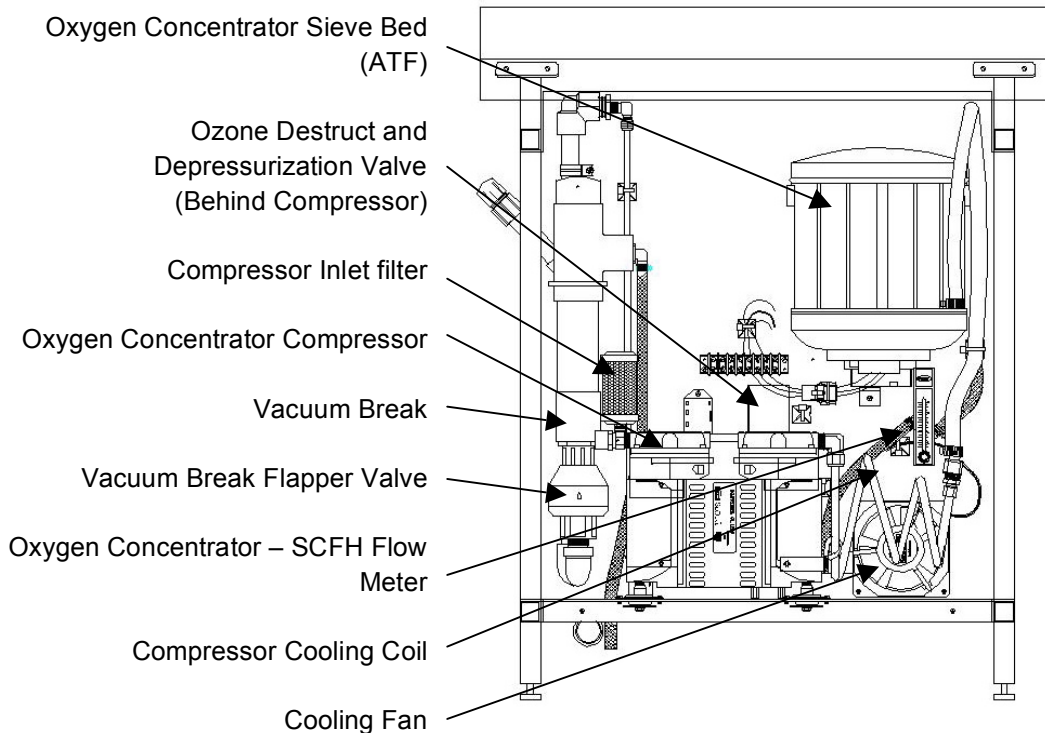
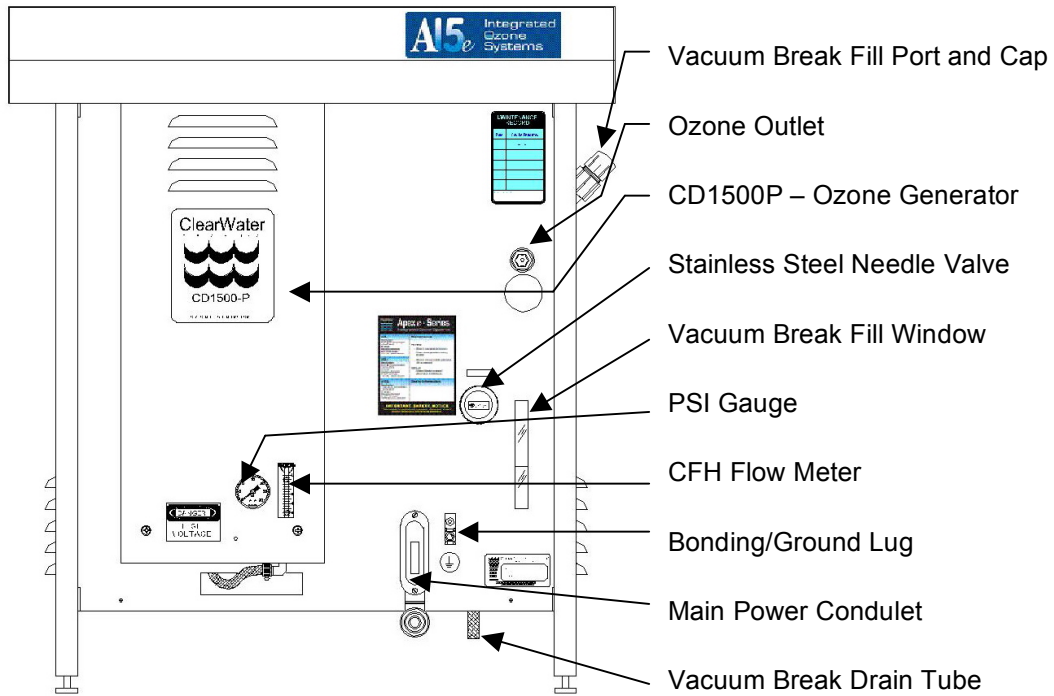
Section A – Specifications

A8e – Ozone Generator



Shown: ClearWater Tech CD12 Ozone Generator (Wire harness omitted for clarity)

Section A – Specifications

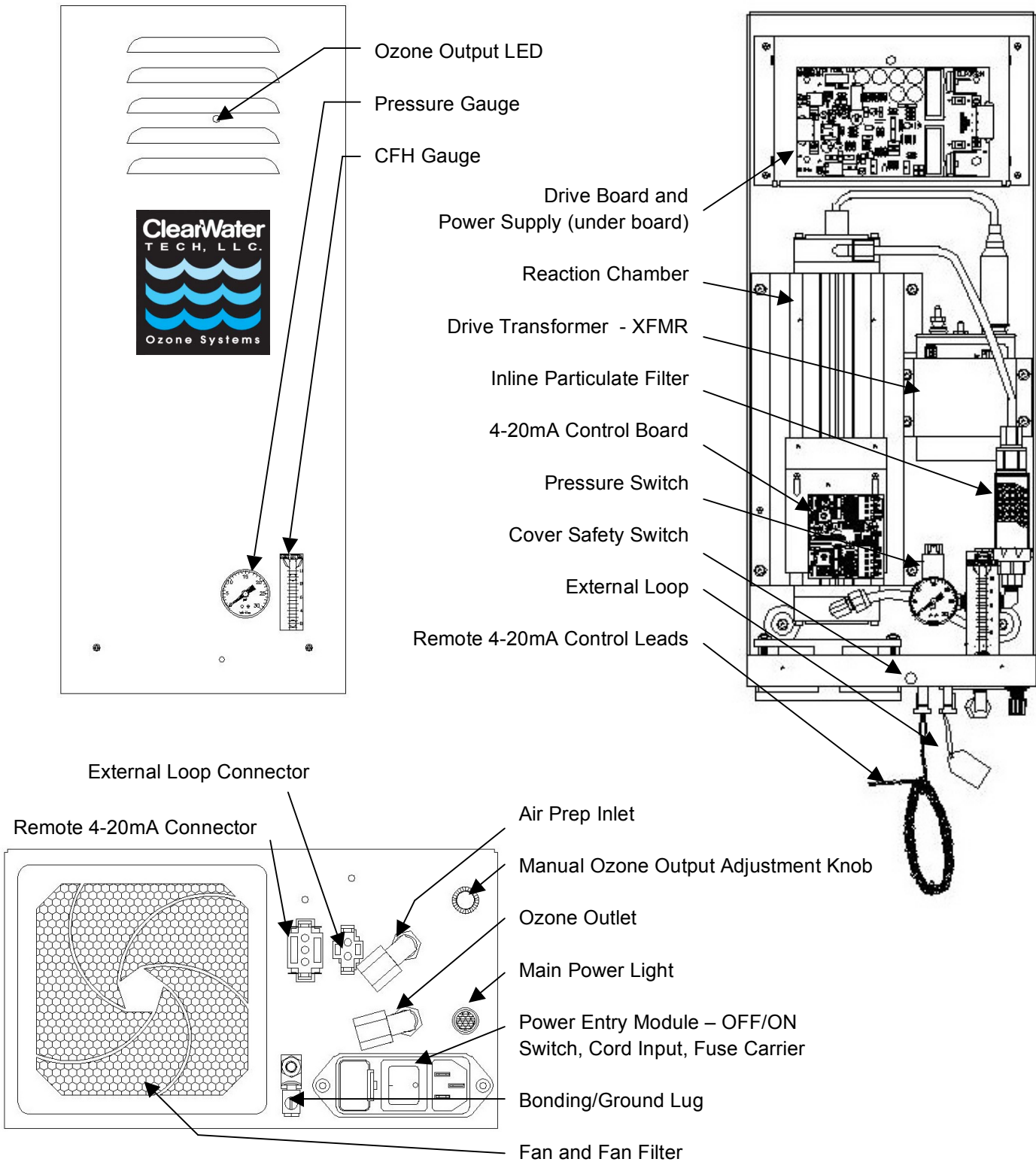


Shown: ClearWater Tech A15e Ozone Generation System (Wire harness omitted for clarity)

OZONE SYSTEM	SPECIFICATIONS	OZONE OUTPUT/SCFH
A15e	32.5 +1.0/-0.5 h x 28" w x 22" d, 45 lbs	15g/h, 6% @ 6 scfh

Section A – Specifications

A15e – Ozone Generator



Shown: ClearWater Tech CD1500P Ozone Generator (Wire harness omitted for clarity)

APPENDIX - Section B

Parts List

Ae Ozone Generation Systems

Description	Part #
Compressor Inlet Filter – A4e, A8e, A15e	OXS350
Compressor Rebuild Kit – A4e, A8e, A15e	OXS356
Compressor Pressure Relief Valve – A4e, A8e, A15e	OXS361
Reaction Chamber Complete 1” Vacuum – A4e, A8e	RCC17
Reaction Chamber Complete 2” Pressurized – A15e	RCC9
Dielectric Anode 1” – A4e, A8e	RCC76
Dielectric Anode 2” – A15e	RCC71
Non-High Voltage End Cap – A4e, A8e	RCC57
High Voltage End Cap – A4e, A8e	RCC53
Non-High Voltage End Cap – A15e	Contact Dealer
High Voltage End Cap – A15e	Contact Dealer
O-ring Set – A4e, A8e	ORS50
O-ring Set – A15e	ORS40
Mother Board – A4e, A8e	ELPC5012
Output Control Board – A4e, A8e	ELPC5031
High Voltage Drive Board – A4e, A8e	ELPC5040
High Voltage Drive Board – A8e	ELPC5042
LED Display Board – A4e	ELPC5054

Description	Part #
LED Display Board – A8e	ELPC5052
Complete Board Set – A4e	ELPC5064
Complete Board Set – A8e	ELPC5062
High Voltage Transformer – A4e	ELTR100
High Voltage Transformer – A8e	ELTR105
Power Supply – 48VDC, 130w, A15e	PSR812
Drive Module Transformer – A15e	HVT200
Drive Module Board – A15e	ELPC5210
4-20mA Control Board – A15e	ELPC5430
Cooling Fan – Ozone Generator, 24VDC - A4e, A8e, A15e	FA47
Cooling Fan – Back Compartment, 120VAC 60Hz, A4e, A8e, A15e	FA41
Cooling Fan – Back Compartment, 240VAC 50/60Hz, A4e, A8e, A15e	FA42
Cooling Fan Filter – A4e, A8e, A15e	FA40
Inline Particulate Filter – A4e, A8e, A15e	FLT34
Depressurization Valve – A4e, A8e	SV200
Depressurization Valve Rebuild Kit – A15e	SV1500
Fuse, Bussmann MDL-5 – 5 amp, 250VAC Slow Blow, Main Power	FUS20
Fuse, Littelfuse 239003 – 3 amp, 250VAC Slow Blow, Mother Board – A4e, A8e	FUS15
Fuse, Littelfuse Minifuse 297003 - 3 amp, 32VAC, Drive Board – A15e	FUS66

APPENDIX - Section C

Maintenance Kit

ASP400A - Maintenance Kit – A4e

Part #	QTY	Description
OXS350	1	Oxygen Concentrator – Replacement Compressor Inlet Filter
OXS356	1	Oxygen Concentrator – Compressor Rebuild Kit
OXS361	1	Oxygen Concentrator – Compressor Pressure Relief Valve
FA40	1	Filter – Cooling Fan filter
FLT34	1	Filter – Inline Particulate Filter
ORG40	2	O-Ring – 1” CD Reaction Chamber, Small
ORG80	2	O-Ring – 1” CD Reaction Chamber, Large
FUS20	5	Fuse, Bussmann MDL-5 – 5 amp, 250VAC Slow Blow, Main Power
FUS15	1	Fuse, Littlefuse 239003 – 3 amp, 250VAC Slow Blow, Mother Board

ASP420A - Maintenance Kit – A8e

Part #	QTY	Description
OXS350	1	Oxygen Concentrator – Replacement Compressor Inlet Filter
OXS356	1	Oxygen Concentrator – Compressor Rebuild Kit
OXS361	1	Oxygen Concentrator – Compressor Pressure Relief Valve
FA40	1	Filter – Cooling Fan filter
FLT34	1	Filter – Inline Particulate Filter
ORG40	4	O-Ring – 1” CD Reaction Chamber, Small
ORG80	4	O-Ring – 1” CD Reaction Chamber, Large
FUS20	5	Fuse, Bussmann MDL-5 – 5 amp, 250VAC Slow Blow, Main Power
FUS15	1	Fuse, Littlefuse 239003 – 3 amp, 250VAC Slow Blow, Mother Board

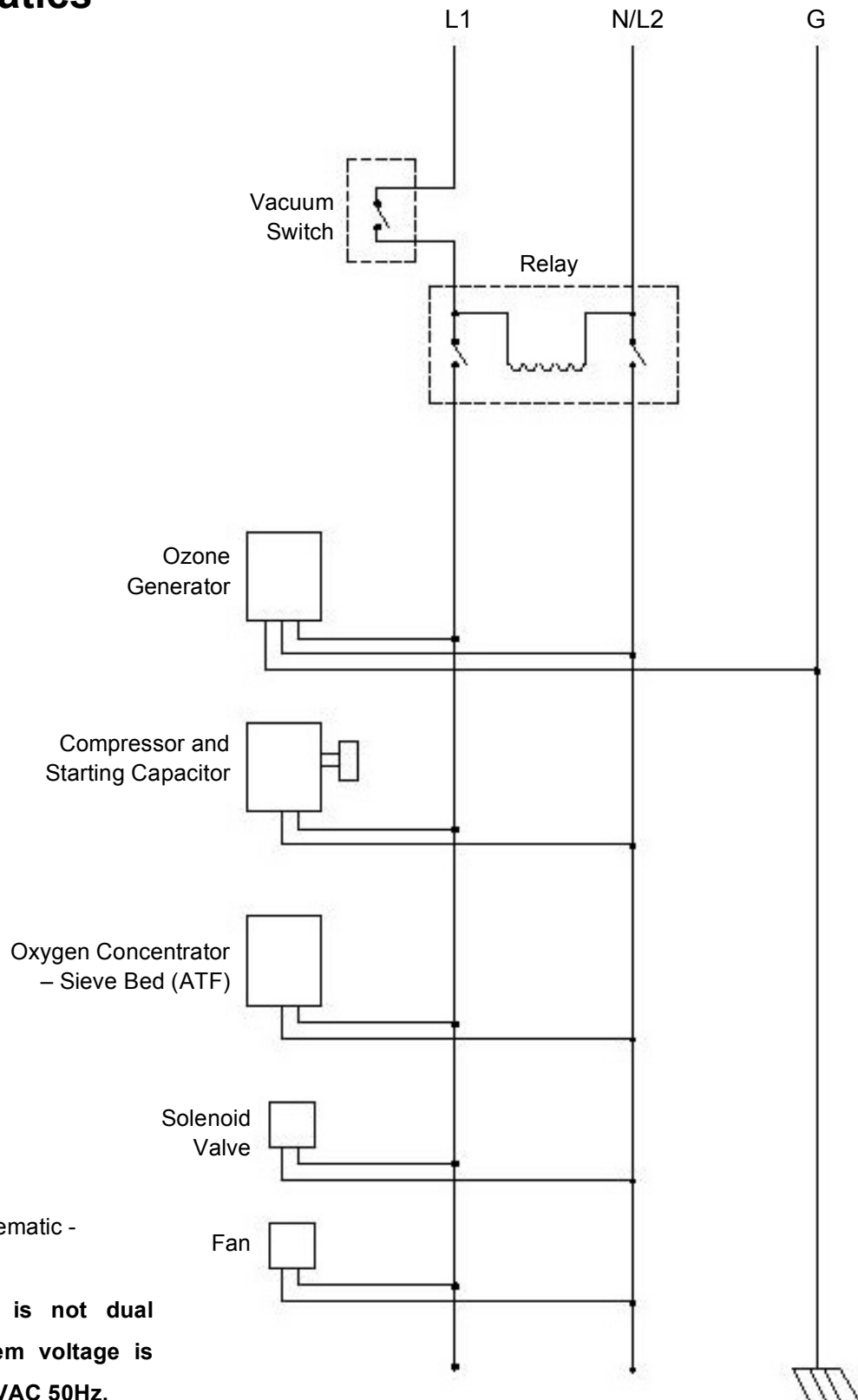
ASP440A - Maintenance Kit – A15e

Part #	QTY	Description
OXS350	1	Oxygen Concentrator – Replacement Compressor Inlet Filter
OXS356	1	Oxygen Concentrator – Compressor Rebuild Kit
OXS361	1	Oxygen Concentrator – Compressor Pressure Relief Valve
FA40	1	Filter – Cooling Fan filter
FLT34	1	Filter – Inline Particulate Filter
ORG110	4	O-ring – 2” CD reaction chamber, pressurized end cap, large
ORG120	4	O-ring – 2” CD reaction chamber, pressurized end cap, small
HSW100	2	Sealing Washer - Viton
HWW9004	2	Hardware Washer - #6, Flat, S.S.
SV1500	1	Depressurization Valve – Rebuild Kit
FUS20	5	Fuse, Bussmann MDL-5 - 5 amp, 250VAC Slow Blow, Main Power
FUS15	1	Fuse, Littlefuse 239003 - 3 amp, 250VAC Slow Blow, Mother Board

APPENDIX - Section D

Logic Schematics

A4e System

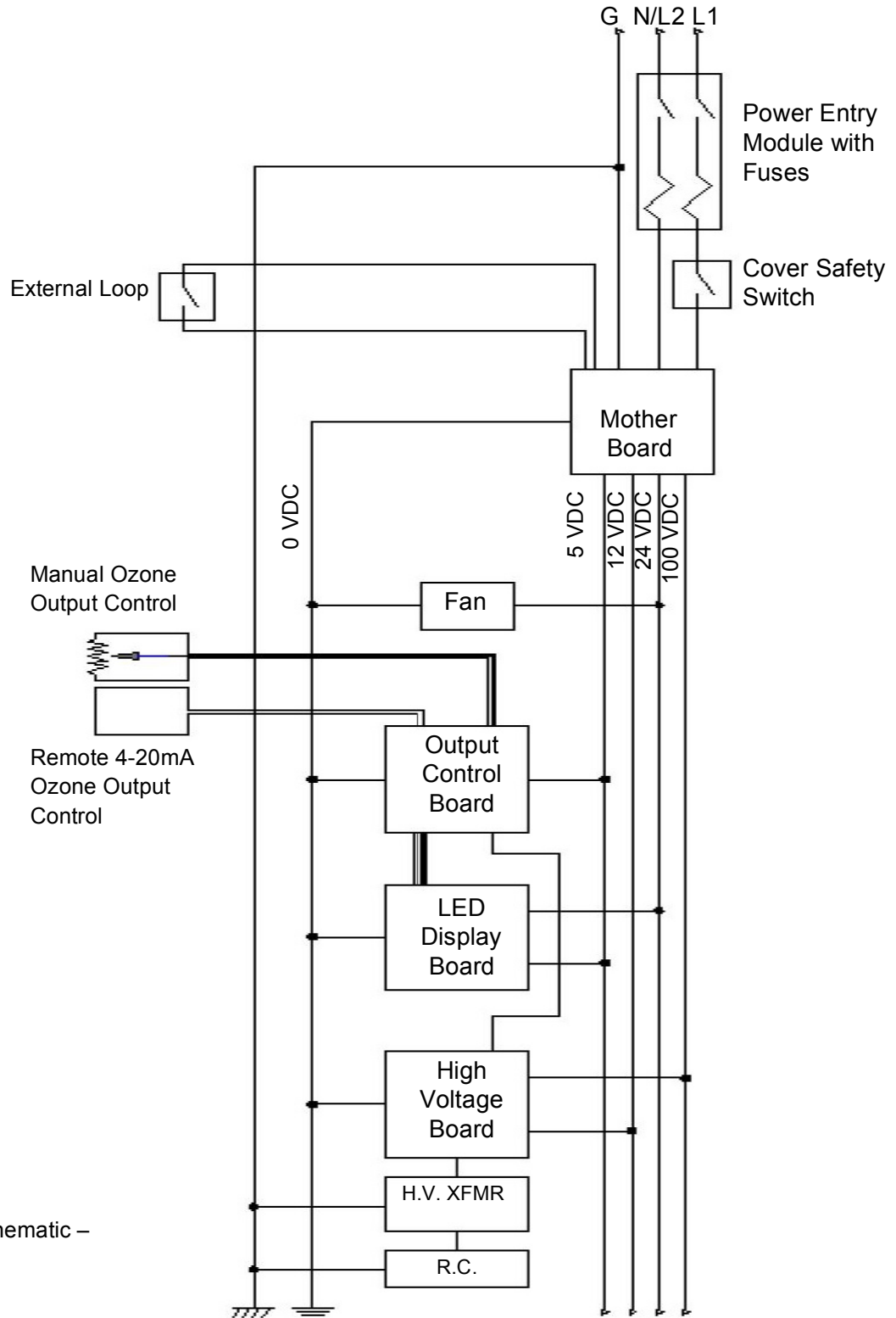


Shown: Electrical Schematic -
A4e Line Side

Note: This system is not dual voltage rated. System voltage is 120VAC 60Hz or 220VAC 50Hz.

Section D - Logic Schematics

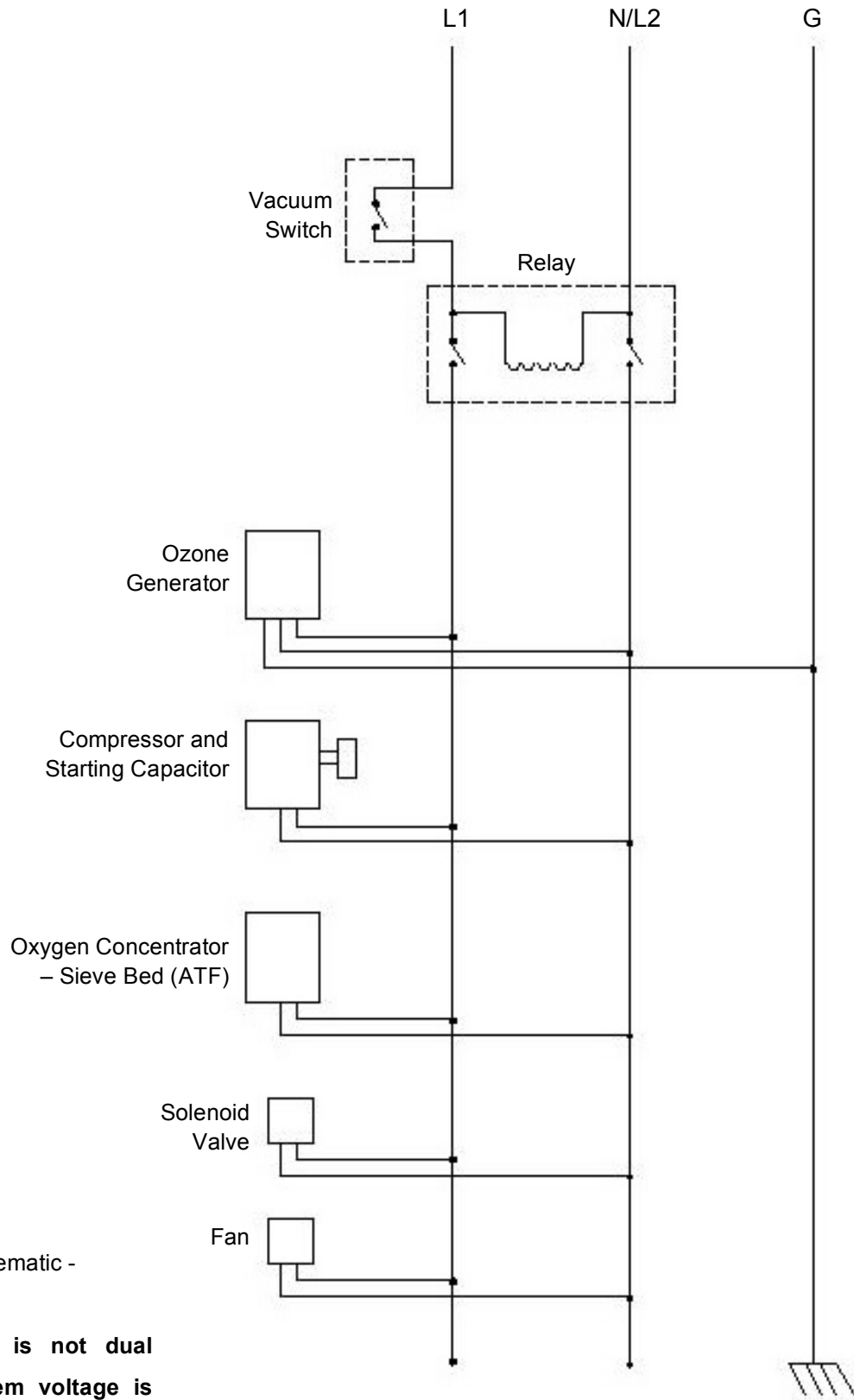
A4e Ozone Generator - CD10



Shown: Electrical Schematic –
CD10 Line Side

Section D - Logic Schematics

A8e System

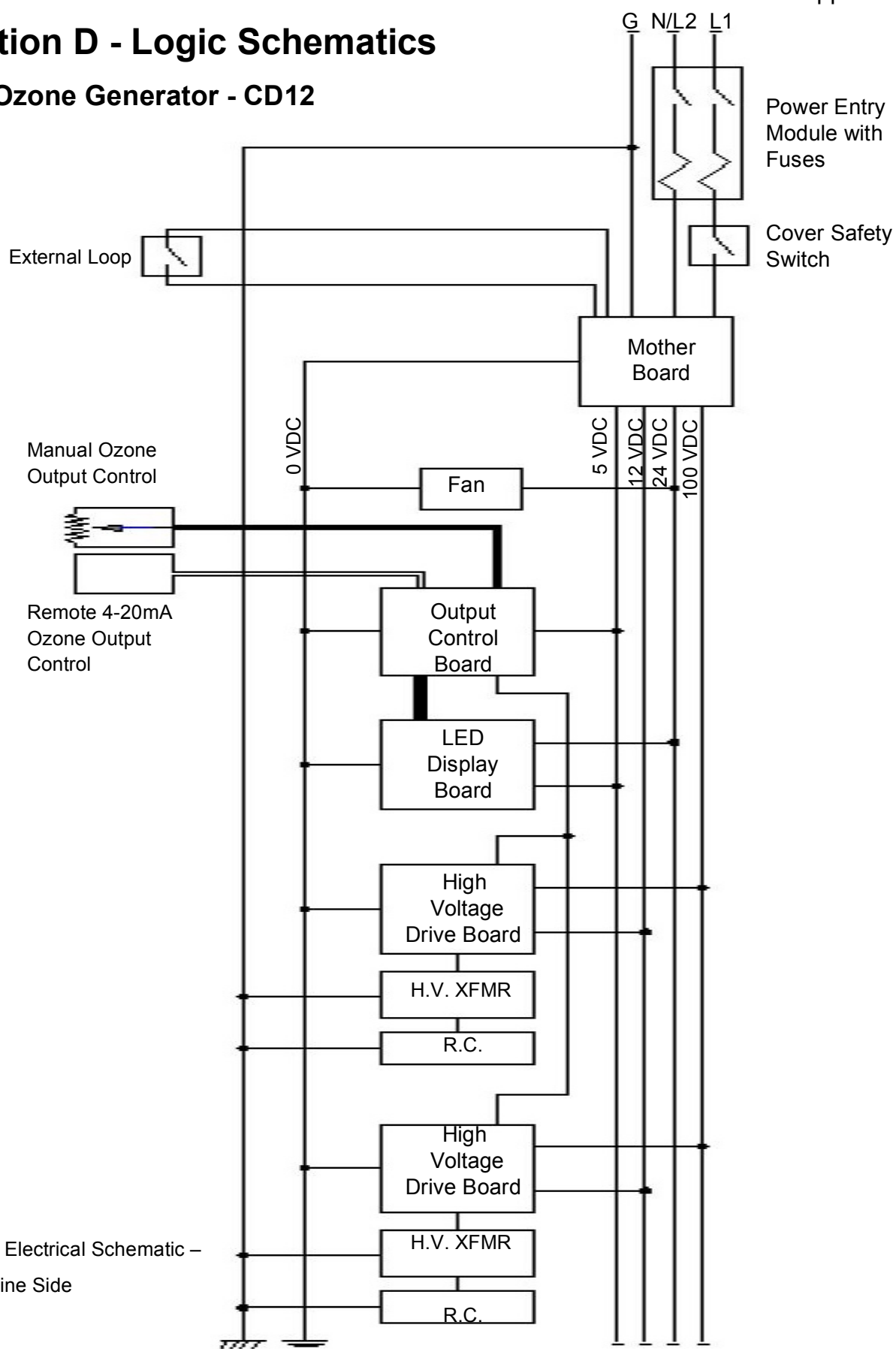


Shown: Electrical Schematic -
A8e Line Side

Note: This system is not dual voltage rated. System voltage is 120VAC 60Hz or 220VAC 50Hz.

Section D - Logic Schematics

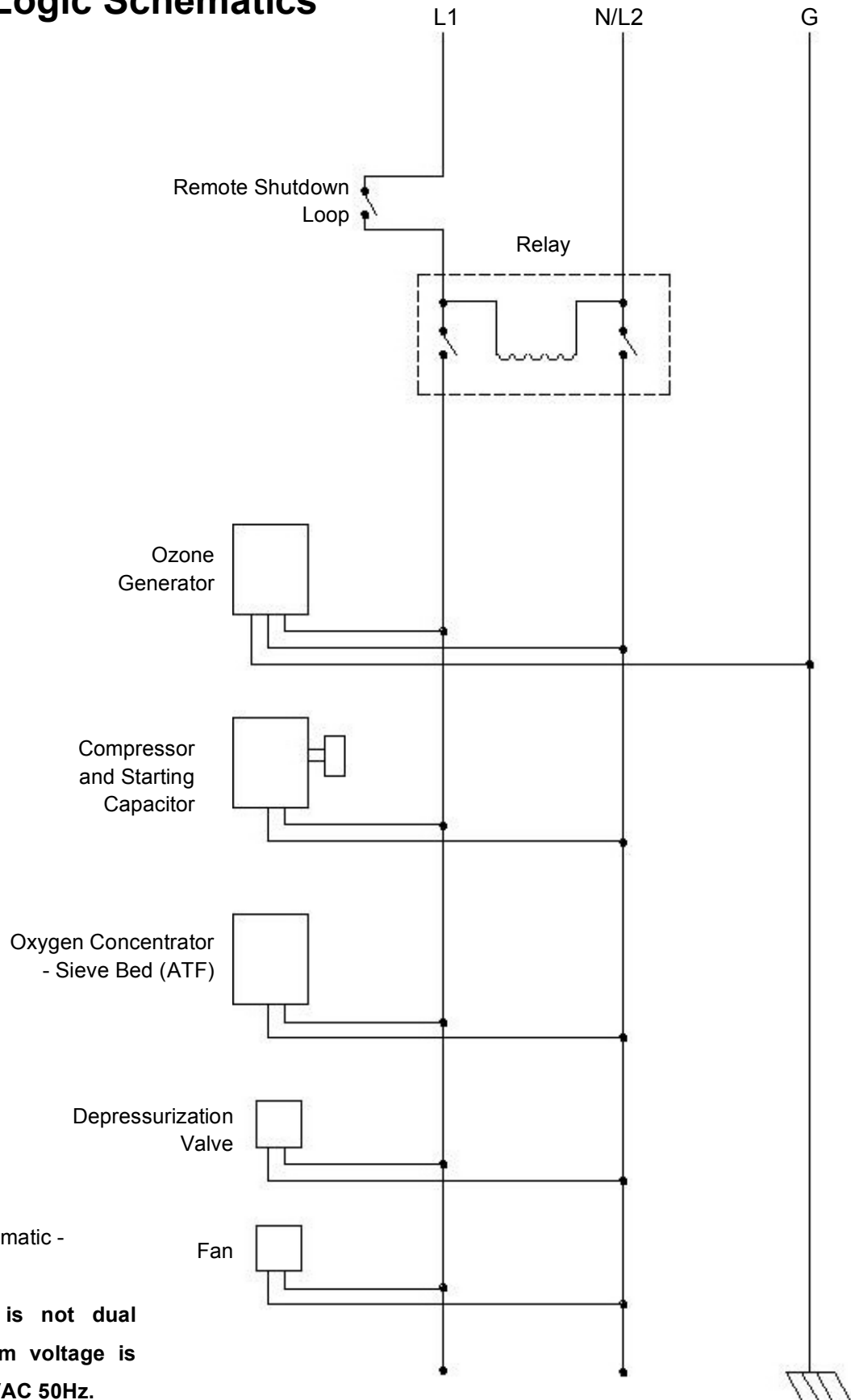
A8e Ozone Generator - CD12



Shown: Electrical Schematic –
CD12 Line Side

Section D - Logic Schematics

A15e System

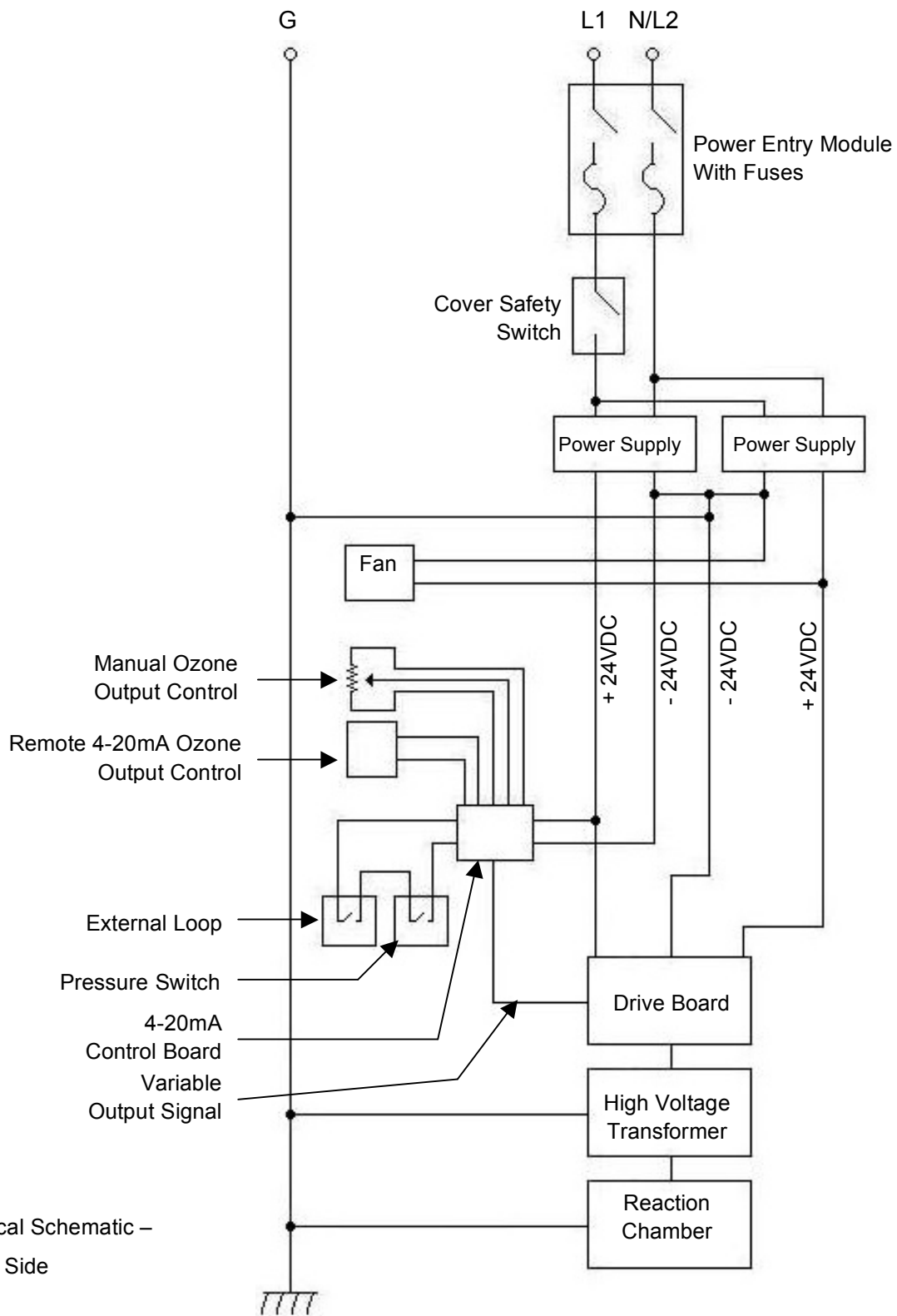


Shown: Electrical Schematic -
A15e Line Side

Note: This system is not dual voltage rated. System voltage is 120VAC 60Hz or 220VAC 50Hz.

Section D - Logic Schematics

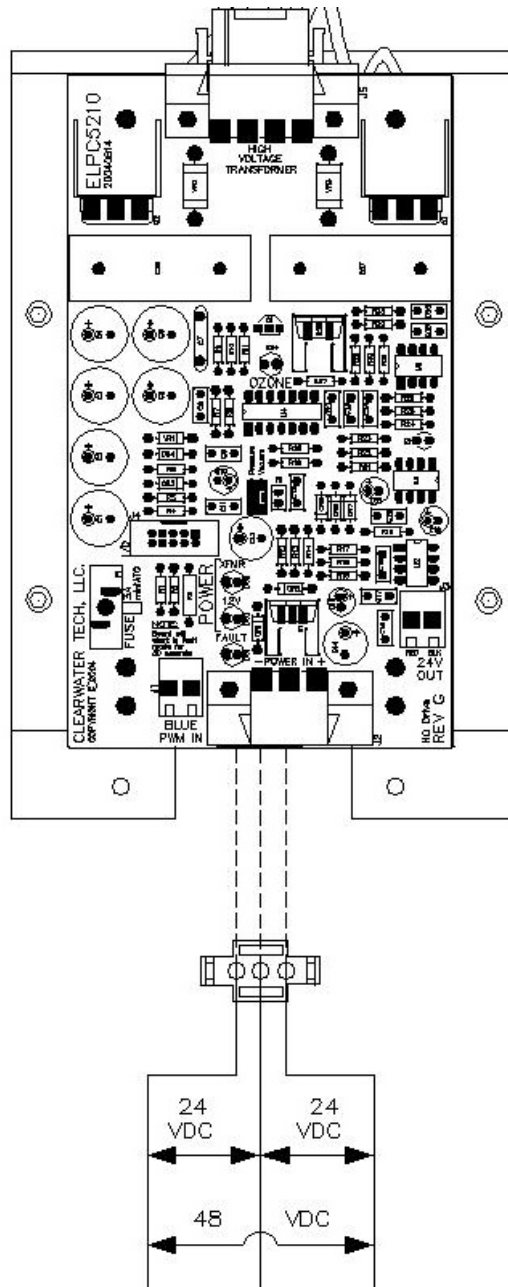
A15e Ozone Generator – CD1500P



Shown: Electrical Schematic –
CD1500P Line Side

APPENDIX - Section E

Drive Board Input Voltage – A15e



APPENDIX - Section F

ClearWater Tech, LLC. Limited One-Year Warranty

Summary of the Warranty

ClearWater Tech, LLC (“CWT”) makes every effort to assure that its products meet high quality and durability standards and warrants the products it manufactures against defects in materials and workmanship for a period of one (1) year, commencing on the date of original shipment from CWT, with the following exceptions: 1) The warranty period shall begin on the installation date if the installation is performed within 90 days of the original shipment from CWT; 2) The warranty period shall begin on the date of the bill of sale to the end user if the installation date is more 90 days after the original shipment date. To validate the warranty, a warranty card, accompanied by a copy of the bill of sale, must be returned to CWT and must include the following information:

- End user name
- Complete address, including telephone number
- Date installed
- Complete model and serial number information
- Name of company from which the unit was purchased

Repairs and replacement parts provided under this warranty shall carry only the unexpired portion of this warranty or 90 days, whichever is longer.

Items Excluded from the Warranty

This warranty does not extend to any product and/or part from which the factory assigned serial number has been removed or which has been damaged or rendered defective as a result of:

- An accident, misuse, alteration or abuse
- An act of God such as flood, earthquake, hurricane, lightning or other disaster resulting only from the forces of nature
- Normal wear and tear
- Operation outside the usage parameters stated in the product user’s manual
- Use of parts not sold by CWT
- Service or unit modification not authorized by CWT
- Check valve/solenoid valve failure
- Damage which may occur during shipping
- Failure to meet service requirements as outlined in the I & O manual

Obtaining Service Under the Warranty

Any product and/or part not performing satisfactorily may be returned to CWT for evaluation. A Return Goods Authorization (RGA) number must first be obtained by either calling or writing your local authorized dealer, distributor or CWT direct, prior to shipping the product. The problem experienced with the product and/or part must be clearly described. The RGA number must appear prominently on the exterior of the shipped box(es). The product and/or part must be packaged either in its original packing material or in comparable and suitable packing material, if the original is not available. You are responsible for paying shipping charges to CWT and for any damages to the product and/or part that may occur during shipment. It is recommended that you insure the shipment for the amount you originally paid for the product and/or part.

If, after the product and/or part is returned prepaid and evaluated by CWT, it proves to be defective while under warranty, CWT will, at its election, either repair or replace the defective product and/or part and will return ship at lowest cost transportation prepaid to you **except for shipments going outside the 50 states of the United States of America**. If upon inspection, it is determined that there is no defect or that the damage to the product and/or part resulted from causes not within the scope of this limited warranty, then you must bear the cost of repair or replacement of damaged product and/or part and all return freight charges. Any unauthorized attempt by the end user to repair CWT manufactured products without prior permission shall void any and all warranties. For service, contact your authorized dealer or distributor or CWT direct at (805) 549-9724.

Exclusive Warranty

There is no other expressed warranty on CWT products and/or parts. Neither this warranty, nor any other warranty, expressed or implied, including any implied warranties or merchantability of fitness, shall extend beyond the warranty period. Some states do not allow limitation on how long an implied warranty lasts, so that the above limitation or exclusion may not apply to you.

Disclaimer of Incidental and Consequential Damages

No responsibility is assumed for any incidental or consequential damages; this includes any damage to another product or products resulting from such a defect. Some states do not allow the exclusion or limitation of incidental or consequential damages, so that above limitation or exclusion may not apply to you.

Legal Remedies of Purchaser

This warranty gives you specific legal rights and you may also have other rights, which vary from state to state.

THIS STATEMENT OF WARRANTY SUPERSEDES ALL OTHERS PROVIDED TO YOU AT ANY PRIOR TIME.