

Ozone Systems

Installation & Operation Manual

CD1500P • CD2000P

Corona Discharge Ozone Generators



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

ClearWater Tech, LLC.

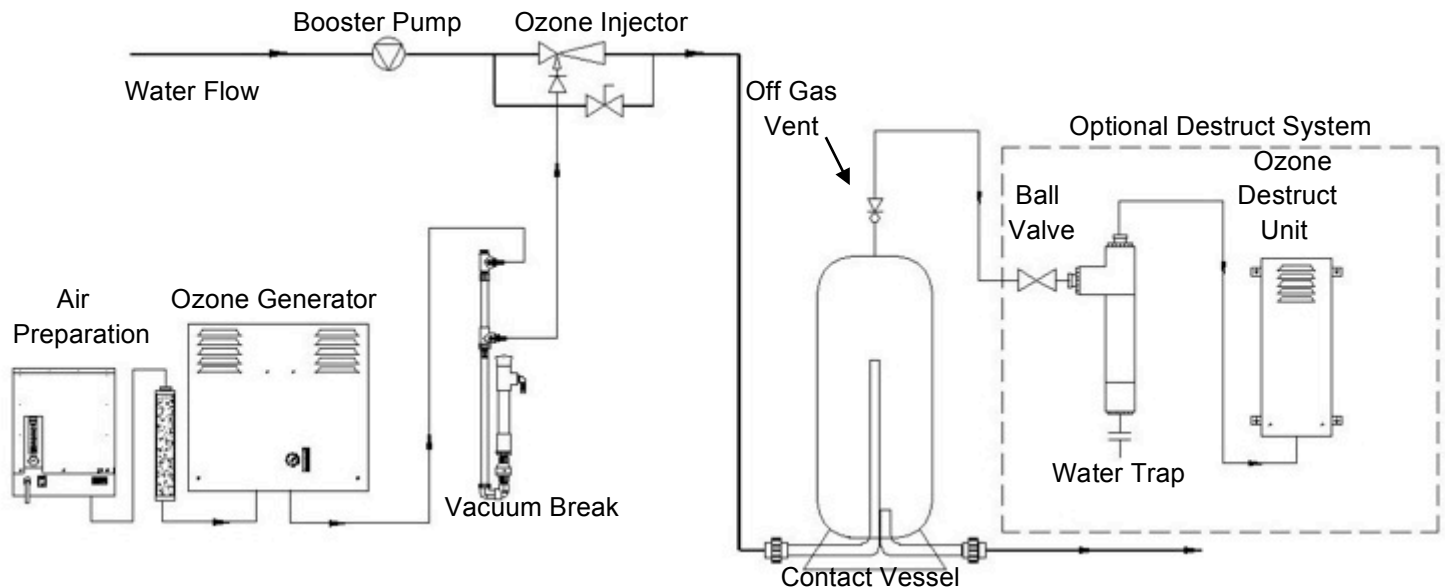
Integrated Ozone Systems

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ClearWater Tech ozone systems are designed for safe, effective use in a variety of water treatment applications. The CD1500P, and CD2000P 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



Shown: ClearWater Tech CDCD2000P Ozone System

Air Preparation System

ClearWater Tech pressurized ozone generators require a source of clean, dry, oil-free, oxygen-enriched air for effective ozone production. To meet that need, ClearWater Tech employs pressure swing adsorption (PSA) technology with an 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.

If “Plant Air” feed gas is to be used in place of the ClearWater Tech air preparation system, the same air quality standards must be met to achieve the ozone output and longevity of the ozone generator. A pounds per square inch (PSI) regulator must be installed when using plant air feed gas. This regulator must be set to a maximum of 10 PSI.

Ozone Generator

ClearWater Tech pressurized ozone generators are 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 externally at the ozone outlet, is used to maintain optimum pneumatic parameters inside the ozone reaction chambers. After this point the vacuum created at the ozone injector *draws* the ozone gas into the water line. The ozone generator is equipped with a pressure switch, which prevents operation if pressure within the reaction chambers drops below 9 PSI.

As the feed gas 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. The modular, multiple reaction chamber design allows the ozone generator to keep working even if one or more of the chambers requires service.

Depending on the application, the ClearWater Tech ozone generator may be interlocked with an ORP controller, PPM controller, pressure switch, timer or circulation pump. Other safety features are also built in, including thermal protection.

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 ClearWater Tech contacting system may also be required. 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(s) when it is impractical to send the off gas to atmosphere or reintroduce it to the water.

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

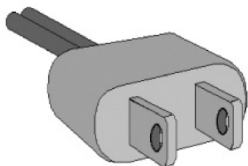
Two aspects of ClearWater Tech ozone generators represent potential dangers – ozone gas and high voltage electricity.

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

This ClearWater Tech corona discharge ozone generator is designed to operate under a 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 corona discharge ozone generators take line voltage and convert it to 48 VDC. A high voltage transformer then boosts the voltage. While each ozone generator has a door switch and other safety interlocks, proper care must be used by a qualified electrician when making any internal adjustments or performing any maintenance procedures.

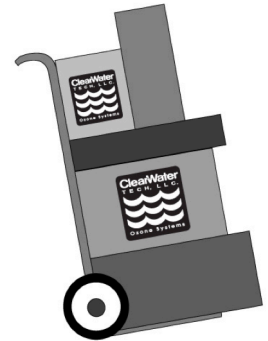
IMPORTANT SAFETY INSTRUCTIONS

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 and a vacuum break 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 of the ozone generator. 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 in the equipment room, 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 each air preparation system and ozone generator are included in Section A of the Appendix.
- The air preparation system and ozone generator should be located as close as possible to the point of ozone injection. 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).
 - In a Sidestream plumbing configuration (see Figure 4-1) with recirculation, the pH adjustment chemical injection point must be located *downstream* of the residual sanitizer injection point (if so equipped).
 - In a Full Flow plumbing configuration (see Figure 4-2) without recirculation, locate *downstream* of the pH adjustment chemical injection point.
 - Adequate protection from weather, dust and excessive heat.
- Like any electronic component, performance and longevity is enhanced by favorable operating conditions. Also, since each 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 air preparation system and ozone generator. These components should be securely fastened to the surface using the mounting holes and/or tabs provided.
- The air preparation system and ozone generator are *not* designed to withstand outdoor elements, including direct contact 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 loop 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.

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 present in the system (such as a heater bypass valve, etc.), it will require installation of a valve (butterfly, gate or ball) or a flow controller.
- Step 3:** Plumb a line from the tee or plumbing saddle to the booster pump. For serviceability of the equipment in the sidestream loop, 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, install it onto the top opening of the injector.
- Step 5:** Plumb from the injector manifold to the inlet side of the contact vessel. 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. ClearWater Tech contact columns 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.** The inlet on the 264, 463 and 850-gallon tanks is located at the top with the outlet at the bottom.
- 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 in the side stream loop, 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 4-3, 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.

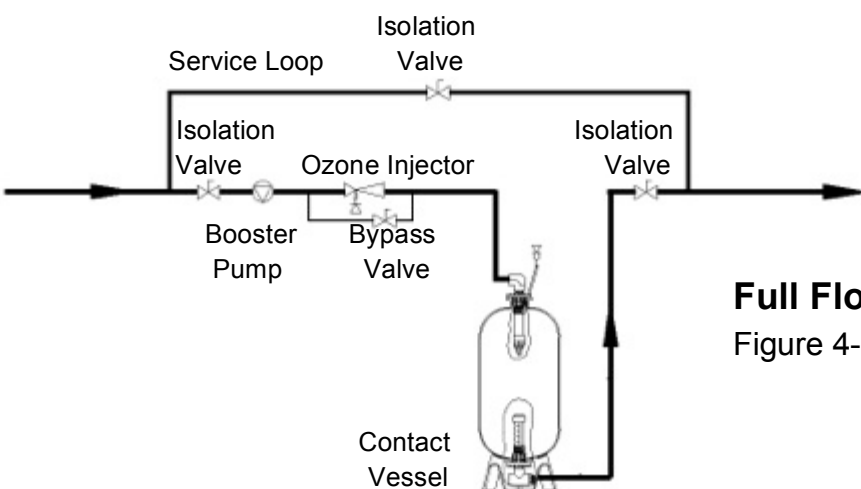
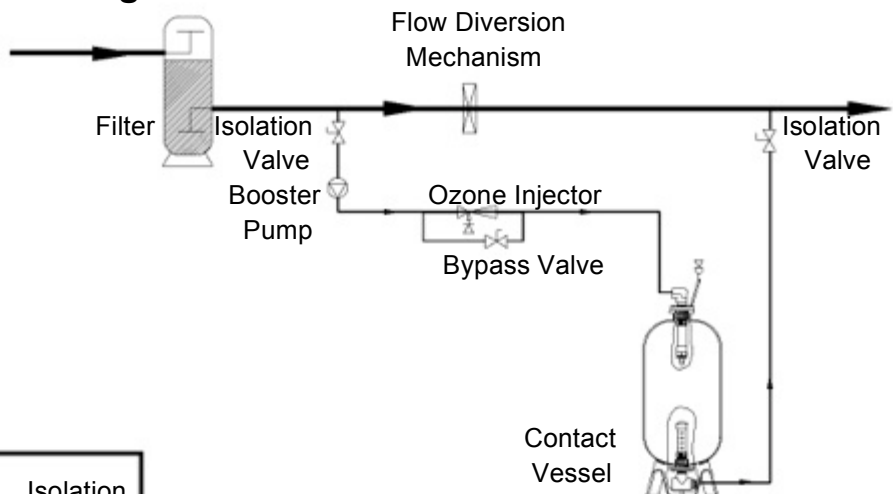
Step 3: Cut the unistrut bar to the desired length and attach it to the 'L' bracket using hardware provided.

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 Plumbing Installation Diagram

Figure 4-1

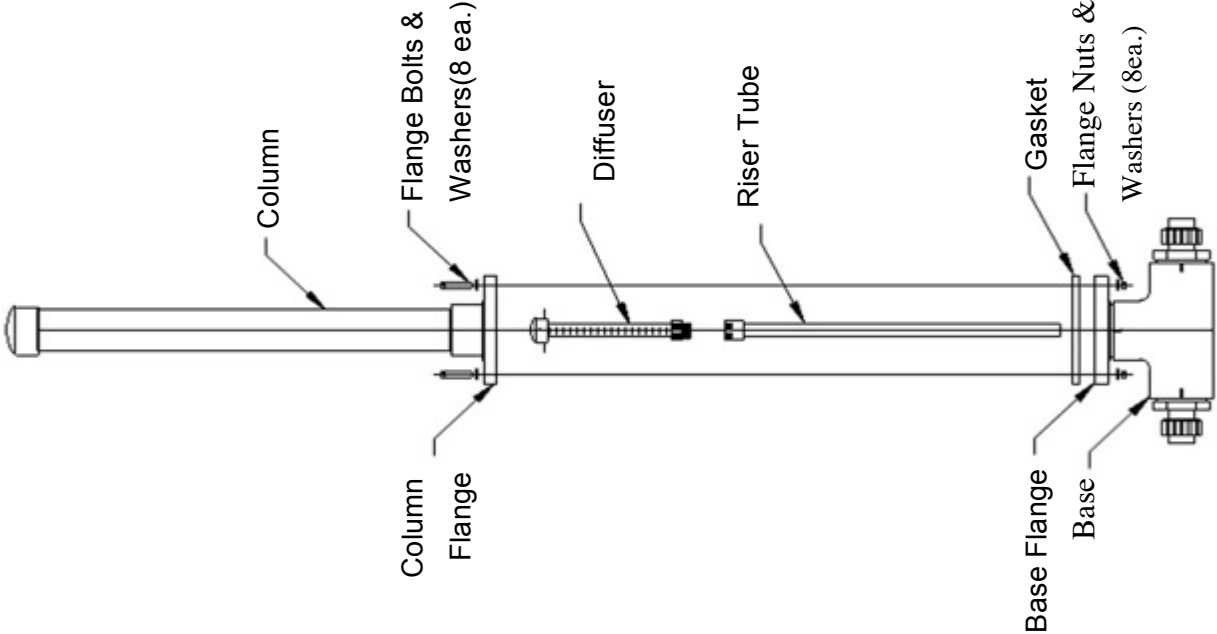
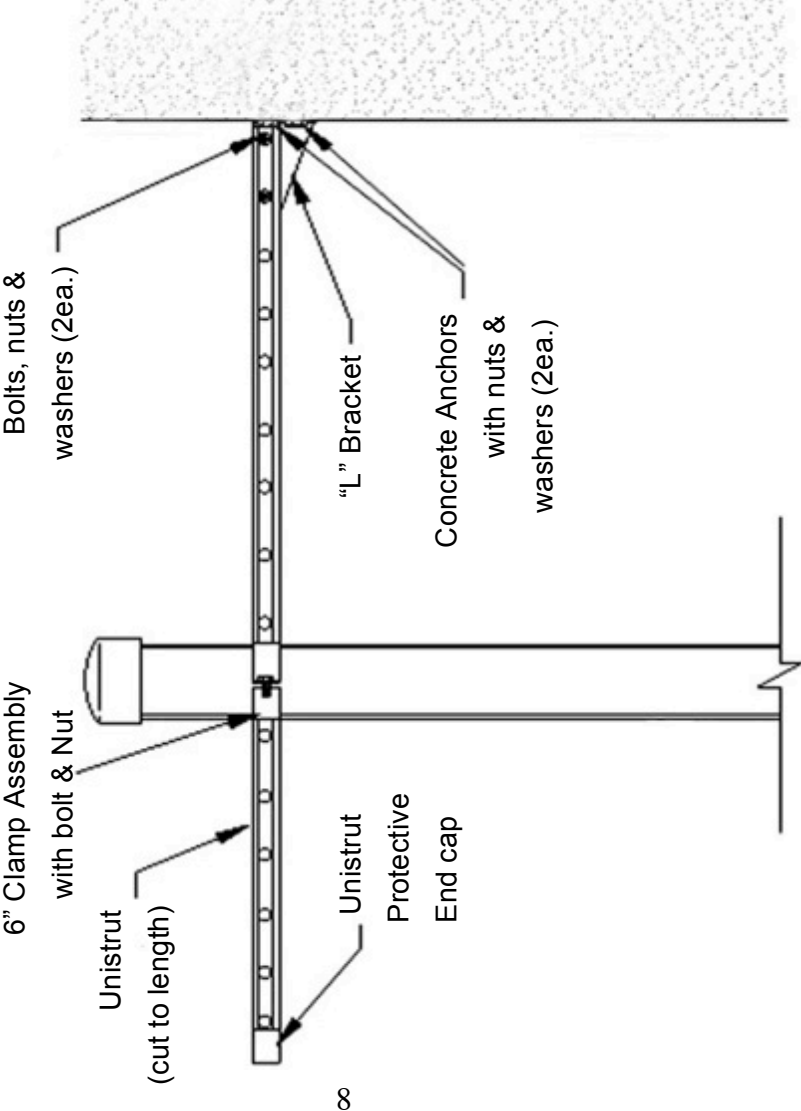


Full Flow Plumbing Installation Diagram

Figure 4-2

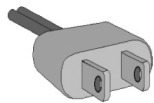
Contact Column Installation Diagram

Figure 4-3



Contact Column Exploded View

Figure 4-4



The CD1500P and CD2000P ozone generators are equipped with universal regulated power supplies that accept an input voltage from 90-250VAC at 47-63Hz, single phase (1Ø). ClearWater Tech

has an assortment of IEC cords for various voltage requirements and outlet configurations, for use around the world. All possible pre-wiring has been completed at the factory. Logic schematics have been provided in the Appendix-Section D.

- 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 ozone generator 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: Plug the IEC end of the power cord into the power entry module located at the bottom of the ozone generator. The other end can be plugged into any main power source with input voltage from 90 to 250 VAC at 47 to 63 Hz, single phase.

Power Consumption	
Input Voltage	90-250VAC 47-63Hz
CD1500P	1.6 - 0.8 amps
CD2000P	2.8 - 1.4 amps

Step 3: External Loop (EXT LOOP): The external loop is a true dry contact interface. **Note: The term ‘dry contact’ means that this loop does not supply output nor except input voltages.** **Warning: Supplying voltage to the external loop will cause damage to the ozone generator and void warranty.** Under normal operation, the external loop will effectively interrupt the ozone output when the loop has lost continuity; this will also illuminate the LED located on the 4-20mA control board inside the ozone generator (see Appendix, Section A, for location of board) and turn off the “Ozone Output” LED(s) on the front cover. **Note: When the external loop has lost continuity main power to the ozone generator will remain “ON” giving power to the cooling fan(s).** When continuity is present through the external loop, ozone output will continue. This continuity will effectively turn “OFF” the LED of the 4-20mA board and will again illuminate the “Ozone Output” LED(s).

The external loop, a removable two-position plug with a white 18AWG wire located at the bottom panel of the ozone generator (see Appendix, Section A), can be interfaced to any control device, i.e., pressure switch, vacuum switch, flow switch, float switch, ORP controller, PPM controller, or timer. To interface a control device to the external loop, cut the white 18AWG wire in half. Connect the control device to each leg of the external loop. **Note: External Loop control devices supplied by ClearWater Tech may come equipped with a two-position male connector ready to be plugged into the female two-position connector mounted to the chassis of the ozone generator.** If the control device used supplies an output voltage a single pole single throw (SPST) normally-open relay may be used to create a dry contact interface (see Figure 5-1, “External Loop Electrical Interface”). **Note: Attached to the white 18 AWG external loop is a warning, “THIS CONNECTION IS A DRY CONTACT ONLY, DO NOT APPLY VOLTAGE”.**

Step 4: Ozone Output Control: The CD1500P and CD2000P ozone generators are equipped with two options for controlling the ozone output. The first option is a manual 0-100% ozone output control and the second is a remote 4-20mA control signal. The manual ozone output control knob and remote 4-20mA control leads (orange and purple) are located at the bottom of the ozone generator (see Appendix, Section A).

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 level is indicated by the “Ozone Output” LED(s) on the front cover of the ozone generator (see Appendix, Section A).
2. **Remote 4-20mA Control:** A 4-20mA control signal to the ozone generator may be used to control the ozone generator output. 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 level is indicated by the “Ozone Output” LED(s) on the front cover 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.**

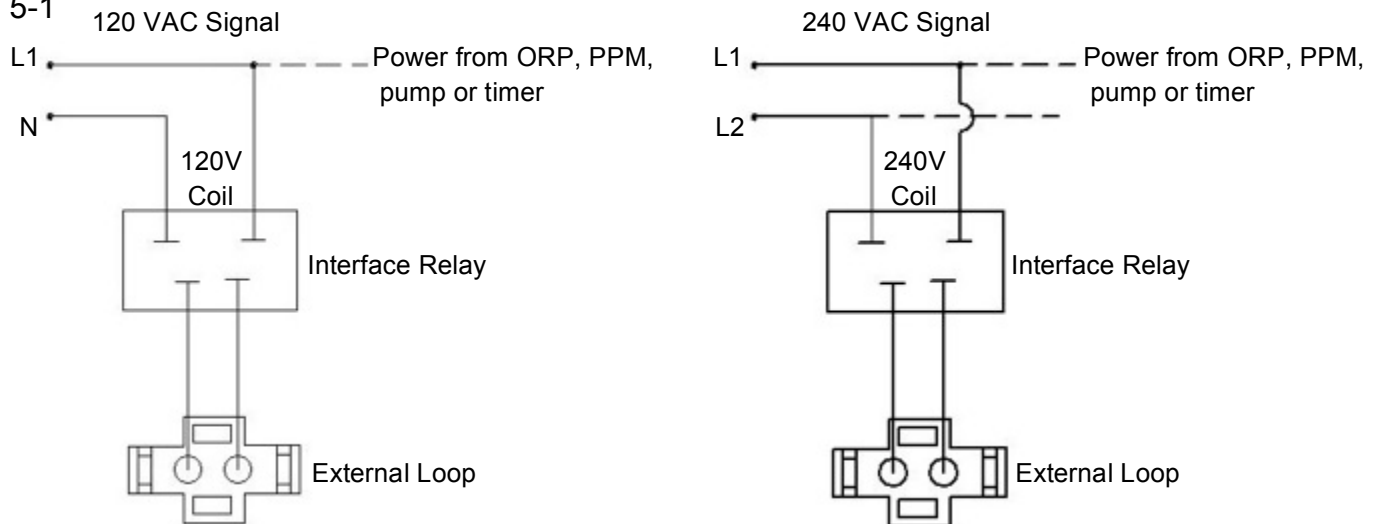
- Step 1:** Mount the 4-20mA controller to a suitable vertical surface according to the installation manual supplied with the controller.
- Step 2:** Wire the #22 AWG orange ‘positive’ (+) lead from the ozone generator to the 4-20mA controller according to the manual supplied with the controller.
- Step 3:** Wire the #22 AWG purple ‘negative’ (-) lead from the ozone generator to the 4-20mA controller according to the manual supplied with the controller.
- Step 4:** Complete the required programming and calibration steps as outlined in the installation manual supplied with the 4-20mA controller.

Step 5: Air Preparation System Power: 120VAC systems only: plug the power cord into main power. 240VAC systems only: the power cord must be hard wired to the main power source (Black-L1, White-L2/N and Green-Ground).

Notes: The prescribed air flow of the air prep system must be set to “atmospheric pressure” prior to use, follow Step 5 of the ‘Start-up & Calibration’ section. **Warnings:** Failure to calibrate may lead to premature failure of the air preparation system. Vacuum from the venturi must be interrupted if the air prep system is not “ON;” failure to do so will damage the air prep system.

External Loop Electrical Interface

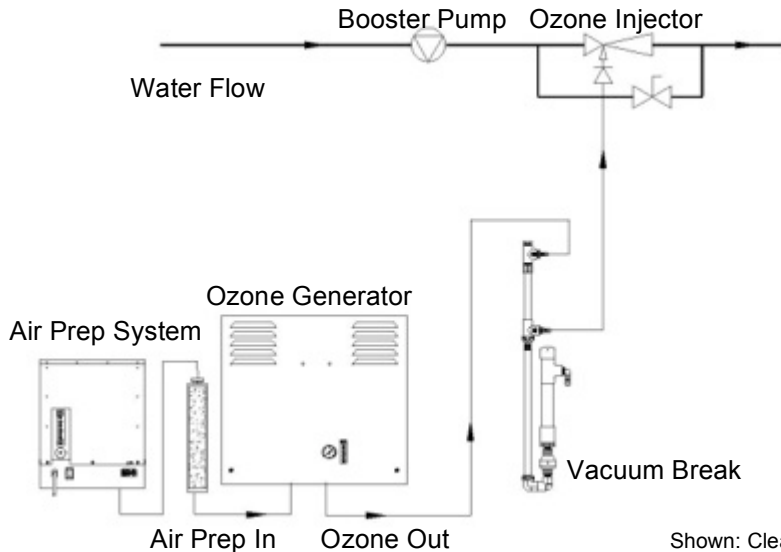
Figure 5-1



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 air preparation system provides the ozone generator with a source of dry, oil-free oxygen-

enriched air (90% +/- 3% oxygen purity at -100°F dew point). The air is drawn from the ozone generator (where ozone is produced from the oxygen in the air stream) and through the vacuum break by the suction created at the ozone injector manifold.

Figure 6-1

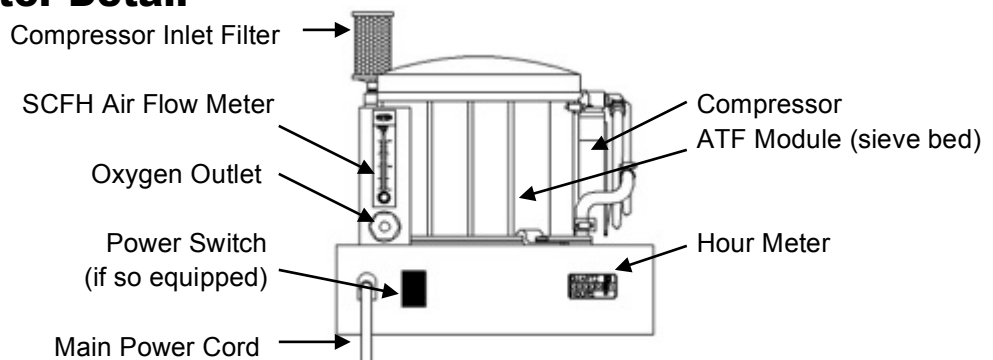


Hook-Up: Air preparation system-to-ozone generator

- Step 1:** Teflon® tape and attach brass barb provided to the PSA oxygen concentrator outlet.
- Step 2:** Teflon® tape and attach brass barbs to both sides of indicator cartridge (ordered separately).
- Step 3:** Mount indicator cartridge on a suitable flat surface using the Clic® mounting clamps provided. **Notes: The indicator cartridge must be mounted vertically. The indicator cartridge does not have a direction of flow.** An external moisture-indicating cartridge is used as a reference to indicate the quality of the dry air, if the air prep system is not operating properly the silica will turn from blue and white in color to all white. See Troubleshooting Guide.
- Step 4:** Using a suitable length of 3/8” braided tubing provided, attach one end of the tubing to the oxygen concentrator system to one end of the indicator cartridge. Secure the tubing to the brass fittings with the hose clamps provided.
- Step 5:** Using a suitable length of 3/8” braided tubing, attach tubing to the brass barb located at the other end of the indicator cartridge then attach the other end of the tubing to the brass barb located at the bottom of the ozone generator. Secure the tubing to the fittings with the hose clamps provided.

Oxygen Concentrator Detail

Figure 6-2



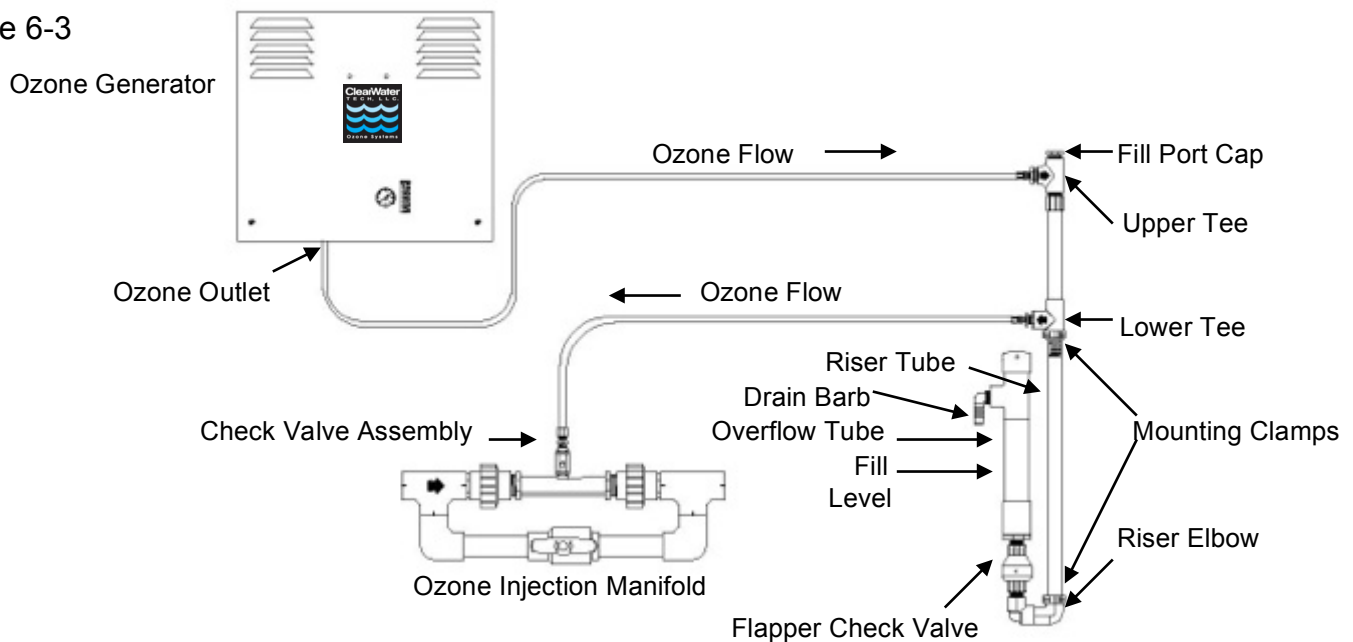
Hook-Ups: Ozone generator-to-vacuum break & vacuum break-to-injector manifold

The ClearWater Tech vacuum break provides a positive atmospheric “break” between the ozone injector manifold and the ozone generator, preventing water from flowing back into the ozone generator should the venturi check valve fail. Under normal operating conditions, the vacuum break’s flapper valve (see Figure 6-3) is closed, allowing the vacuum created by the venturi to draw the output gas from the ozone generator. 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 vacuum break properly installed between the venturi and the ozone generator, the water will flow down the riser tube (away from the ozone generator) and out to drain, protecting the ozone generator from potential water damage. **Note: All Teflon® delivery lines that are secured by a stainless steel compression fittings require a tubing insert (inserts are located in the Vacuum Break parts bag). This insert will prevent crushing of the tubing, which may create an ozone leak. All stainless steel compression fittings must be tightened no more than 1-1/4 turns past finger tight.**

- Step 1:** Select a suitable vertical surface that is accessible and in close proximity to both the ozone generator and the ozone injector manifold.
- Step 2:** Install the two Clic® mounting clamps provided onto the vertical surface so that the vacuum break is in a vertical position and the drain holes are *below* the level of the ozone generators ozone outlet fitting. One clamp should be located so it fits around the Riser Tube Elbow, and the other so it fits around the bottom of the Lower Tee (see Figure 6-3).
- Step 3:** Remove the Fill Port Cap located on top of the Riser Tube and fill the Riser Tube with clean water (no particulate matter) until "Fill Level" line indicated in Figure 6-3.
- Step 4:** Re-install the Fill Port Cap, using pliers or a wrench to tighten. **Note: Do not over tighten as damage to PVC fittings may occur.**
- Step 6:** Connect one end of a suitable length of Teflon® ozone delivery line to the ozone outlet needle valve (see Appendix, Section A). **Notes: The compression fitting ferrules are zip tied to the ozone outlet needle valve.** Attach the other end of the Teflon® delivery line to the fitting threaded into the Upper Tee. As an additional backflow prevention measure, loop this length of tubing as high as is practical between the two connection points.
- Step 7:** Connect one end of a second length of Teflon® delivery line to the fitting threaded into the Lower Tee. The other end of the delivery line will be attached to the fitting located on top of the check valve assembly, in step 6 of Chapter 7, “Start-up and Calibration Procedures.”
- Step 8:** Adjustments to the 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 6-3



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 ozone generator while the system is operating under pressure. Air from the air preparation system 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 on the ozone generator.

Air Preparation System, Ozone Generator & Ozone Injector

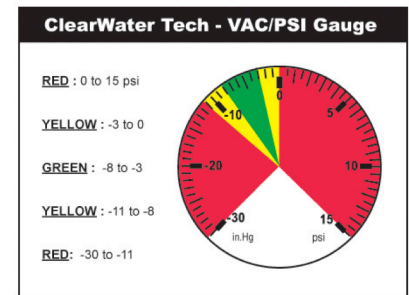
Warning: *Disconnect the External Loop dry contact from the ozone generator while performing all start-up procedures. Failure to do so may result in ozone escaping to atmosphere.*

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 system to reach hydraulic equilibrium (contact vessel full, off-gas vent operating, etc.) and observe for plumbing leaks. **Note:** *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.

Step 4: Using your thumb, check for the presence of vacuum (suction) at the ozone injection manifold check valve assembly or use a ClearWater Tech 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 you must be able to achieve proper SCFH (Standard Cubic Feet per Hour) of air flow (see the “Pneumatic Operating Parameters” chart for venturi SCFH required, Figure 7-1).



Step 5: Make sure electrical power is on to all ozone system electrical components. The main power switch of the air preparation system must be in the “ON” position (if so equipped) (see Figure 6-2). The air preparation system must be set to “atmospheric pressure” prior to full start up of the system. Disconnect the oxygen delivery line from each oxygen concentrator (if delivery has already been attached). **Note:** *This should have been completed in Step 5 of “Installation Procedures - Electrical.”*

Step 1: Check to make sure the compressor of the air preparation system is operating.

Step 2: Using the air flow gauge adjustment valve on the air preparation system (see Figure 6-2), adjust the air flow according to the “Air prep system air flow” specifications outlined in Figure 7-1. **Note:** *When the system is under normal operation, the air flow will drop from the initial setting due to the air preparation system being under back pressure. DO NOT READJUST THE AIR FLOW GAUGE ADJUSTMENT VALVE.*

Step 6: Connect the Teflon® ozone delivery line from the vacuum break to the ozone inlet fitting located at the ozone injection manifold check valve assembly.

Step 7: Using the stainless steel ozone outlet needle valve located at the bottom the ozone generator (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 9 PSI before ozone will begin production.

Start-up and Calibration (continued)

- Step 8:** The CFH gauge on the front panel of the ozone generator will monitor the CFH air flow rate. By setting the oxygen concentrator SCFH and ozone generator back pressure PSI, there will be no adjustments of CFH air flow. See “Air prep system air flow” specifications outlined in Figure 7-1.
- Step 9:** Perform a final check of all air 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:** Reconnect the External Loop connector to the ozone generator. **Note: The Ozone LED(s) will not illuminate until the External Loop has been replaced.**
- Step 11:** Observe all indicating LED(s) on the front cover of the ozone generator. Adjust the manual ozone output knob to desired level setting.

Vacuum Break

Check the water level in the vacuum break, making sure it is *above* the flapper valve (see Figure 6-3). 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 flow from the vacuum break, which in turn can cause an ozone leak. **Note: If the vacuum break must be refilled with water disconnect the External Loop from the ozone generator and disconnect the Teflon® ozone delivery line from the ozone inlet fitting of the vacuum break. This will keep the pressure from the oxygen concentrator from pushing out the water and shutting down ozone production.**

Ozone Destruct System

Adjust the small ball valve at the tee of the water trap (see Figure 6-4) so that only a small amount of water is “spitting” into the trap. This will indicate that the contact vessel is full and only a very small amount of water is allowed to escape.

Pneumatic Operating Parameters

Figure 7-1

CD1500P	Operating Range	Optimum
Air prep system air flow	5 to 6 scfh	6 scfh
Ozone generator total air flow (gauge – 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
Injector manifold injector	-3 to -8 in. hg.	-5 inches

CD2000P	Operating Range	Optimum
Air prep System air flow	10 to 12 scfh	12 scfh
Ozone generator total air flow (gauge – front cover)	4 to 6 cfh	6 cfh
PSI gauge (gauge – front cover)	9 to 12 psi	10 psi
Injector manifold air flow	10 to 12 scfh	12 scfh
Injector manifold injector	-3 to -8 in. hg.	-5 inches

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” in Chapter 2 before attempting any maintenance procedure that requires the use of tools and/or shutting down the ozone system.**

Daily Procedures

Air Preparation System

- **Power Switch:** Check the power switch on the air preparation system (see Figure 6-1), if so equipped.
- **Indicator Cartridge:** Inspect the air preparation system indicator cartridge. A change in the blue crystals to a light pink or white color indicates the presence of moisture in the feed gas coming from the air preparation system. If such a change is observed, refer to the Troubleshooting Guide.
- **Air Flow:** Check the air flow gauge on the air preparation system (see Figure 6-1). Make sure the air flow is within the SCFH range shown on the “Air prep System Air Flow” line of the “Pneumatic Operating Parameters” chart (Figure 7-1). Adjust if necessary by following the steps outlined in the “Start-Up & Calibration” section.

Ozone Generator

- **Indicator Lights:** Check the Main Power indicator light at the bottom of the ozone generator and Ozone LED(s) at the cover of the ozone generator (see Appendix, Section A). The Main Power light should be illuminated when main power to the ozone generator is present and the main power switch is “On.” The Ozone Output LED(s) should be illuminated when the External Loop has continuity, the Manual Ozone Output Adjustment Knob is at a desired setting (other than 0%) or a Remote 4-20mA Control Signal is sensed. See Troubleshooting Guide.
- **Air Flow:** Check the air flow gauge at the ozone generator cover. Make sure air flow is within the CFH (cubic feet per hour) range shown on the “Ozone generator air flow” line of the “Pneumatic Operating Parameters” (see Figure 7-1). Adjust if necessary by following steps outlined in the “Start-Up & Calibration” section.
- **Pressure:** Check the PSI gauge located on the ozone generator cabinet door. Make sure pressure is within the range shown on the “PSI Gauge” line of the “Pneumatic Operating Parameters” chart (see Figure 7-1). Adjust if necessary by following steps outlined in the “Start-Up & Calibration” section.

Vacuum Break

- **Water Level:** Check the water level in the vacuum break. Make sure it is *above* the flapper valve in the overflow tube. Fill as required by removing the threaded fitting on top of the riser tube until water is up to the ‘Fill Level’ in the overflow tube (see Figure 6-3).

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

Maintenance (continued)

- Cooling Fan Operation: Check to make sure the cooling fan mounted on the side panel of the air preparation system is operating. If not, refer to the Troubleshooting Guide.
- Cover Filter: Check the cover filter element mounted on the side of the air preparation system 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.

Ozone Generator

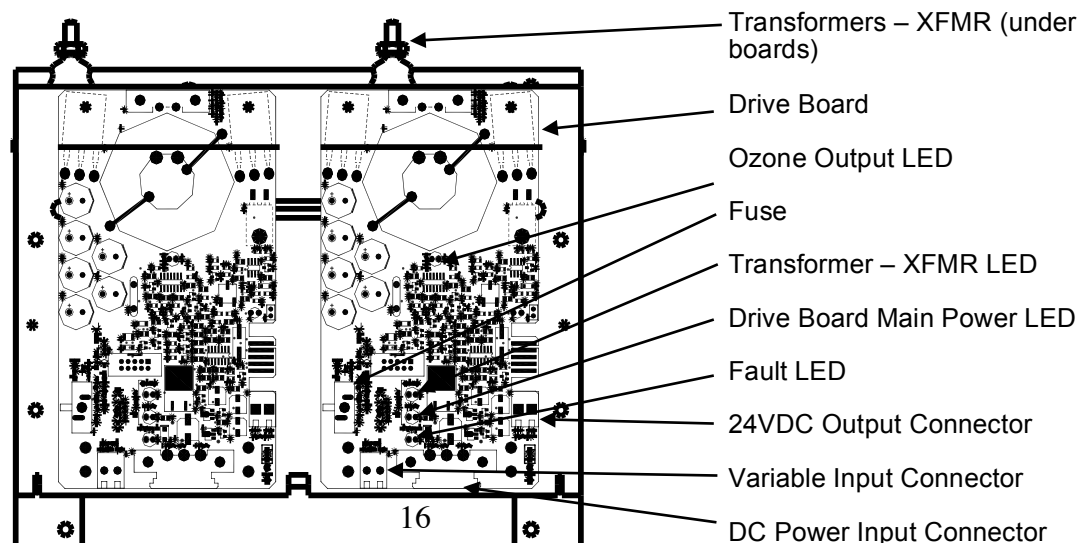
- Drive Module Operation: The Drive Module is made up of two components: the drive board and the drive transformer. With the ozone generator cover removed, check for illumination of the drive module "Ozone Output" LED(s) (for LED locations, see Figure 8-1); if not illuminated see Troubleshooting Guide. This procedure is to *observe* the complete operating function of the drive module(s). Before checking drive module function, remove the ozone generator cover and depress the cover safety switch located on the ozone generator chassis (see Appendix, Section A). **CAUTION: This 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.**
 - Main Power LED: 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.
 - Transformer Power LED: When illuminated, this "Green" LED indicates that 48V Buss power is available to the drive module transformer (XFMR) from the "on board" fuse of the to the drive transformer.
 - Ozone Output LED: The "Amber" ozone output LED will illuminate when ozone drive 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 LED: 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: 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. Before proceeding further, release the cover safety switch and replace the ozone generator cover.**
- Cooling Fan Operation: Check to make sure the two cooling fans (mounted on the bottom panel of the ozone generator cabinet) are operating. If not, refer to the Troubleshooting Guide.
- Cooling Fan Filters: Check the cooling fan filter elements mounted on the bottom of the ozone generator (see Appendix, Section A) 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 8-2).

Booster Pump(s)

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

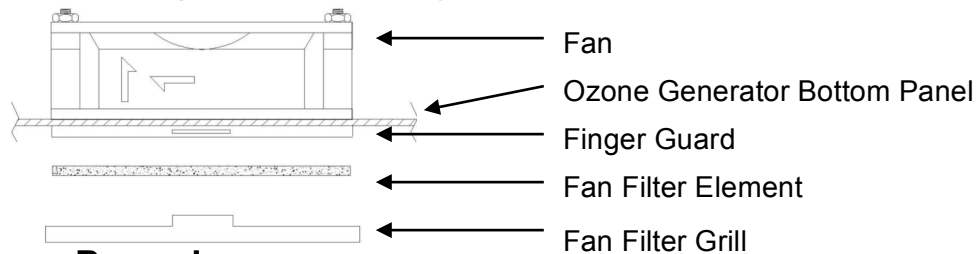
Drive Module High Output (H.O.)

Figure 8-1



Ozone Generator Cooling Fan Assembly

Figure 8-2



System Shutdown Procedures

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

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

Step 2: Turn the Main Power switch on the ozone generator to the “OFF” position. The Ozone Generator Main Power Light at the bottom of the ozone generator and “Ozone Output” LED(s) at the front cover should *not* be illuminated.

Step 3: Disconnect the power to the ozone system either at the service disconnect box (if so equipped) or main circuit breaker.

Semi-Annual Procedures

CAUTION: Follow system shutdown procedures (outlined above) before performing any of the following steps.

Air Preparation System

- Air Inlet Filter: Replace the air compressor inlet filter on each air preparation system module (see Figure 6-2). **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

- Compressors: Following the procedures outlined in the compressor rebuild kit, rebuild the two compressor heads on each air preparation system module (see Figure 6-2). **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 Generators

- Cooling Fan Filters: Clean or replace the cooling fan filter elements as required.
- Inline Filter: Replace the inline particulate filter.
- Reaction Chambers: Remove and disassemble one reaction chamber according to the steps outlined below (see Figure 8-3). Check the chamber interior and dielectric tube for oil, dirt or moisture. **Note: CWT pressurized reaction chambers are anodized blue.**

Removal and Disassembly

Note: Disassembly and service of the reaction chamber is a technical, delicate and critical procedure. Please consult your ClearWater Tech dealer before attempting this procedure.

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 module.

Step 3: Remove the 4-20mA control board with mounting bracket from the reaction chamber of the CD1500P.

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. **Note: The stainless steel clamp must not be removed.**

Step 9: Remove the high voltage end cap and dielectric from the heat sink/cathode assembly. **Note: 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. If cleaning and/or parts replacement is not required, re-assemble the reaction chamber per the instructions below.

Assembly and Re-installation

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: See Figure 8-3 for correct orientation of end cap.**

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).

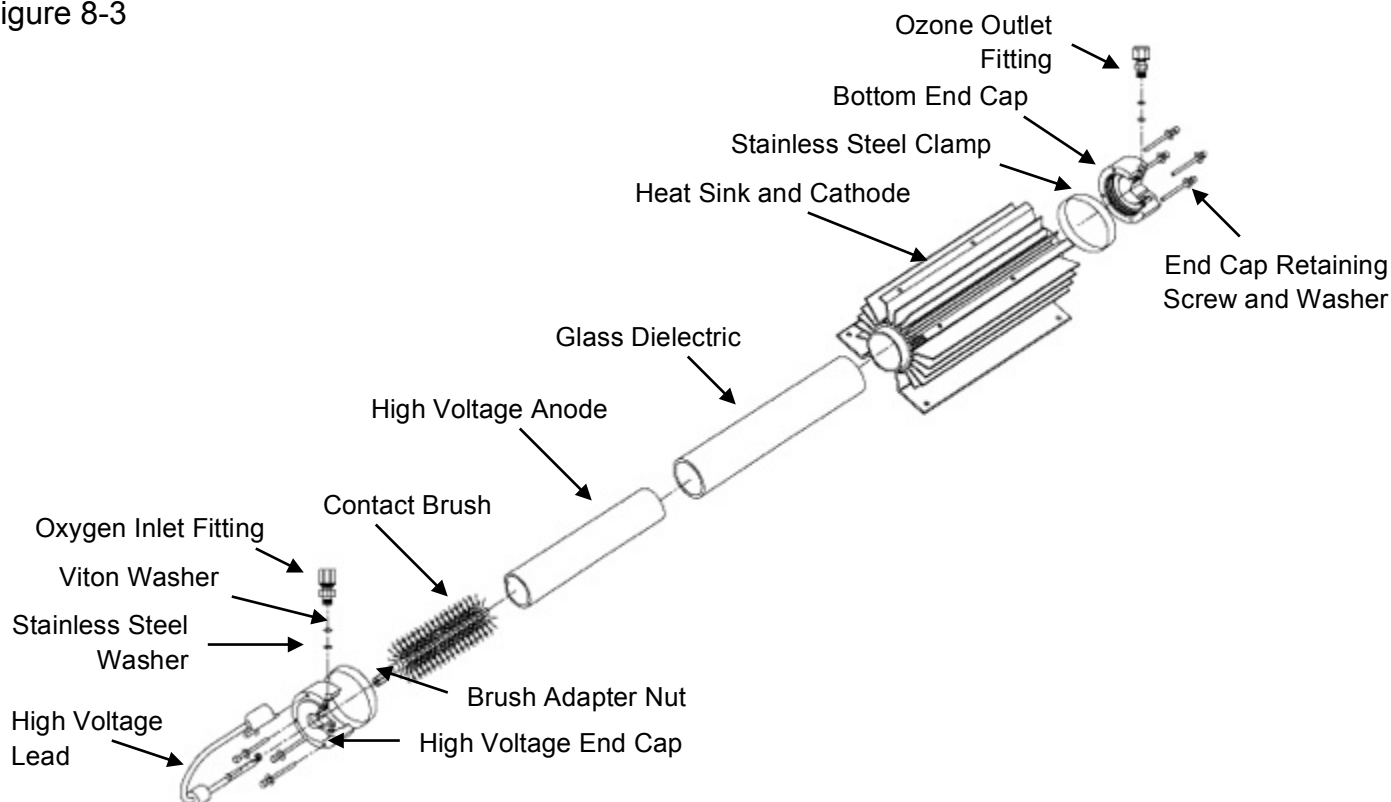
Step 7: *Slowly* insert the high voltage end cap assembly into the dielectric. **Note: Do not bend center wire of the brush during this procedure.** It is normal for the *bristles* to bend. Using a gentle twisting motion, press the high voltage end cap onto the heat sink/cathode assembly until flush with the heat sink cooling fins.

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.

2" Pressurized Reaction Chamber - Exploded View

Figure 8-3



Vacuum Break

- Cleaning: Disconnect ozone delivery lines. Remove the vacuum break from mounting clamps. Disconnect the overflow tube from flapper valve, open flapper and clean the seat with a soft cloth. Remove riser tube threaded fitting and flush riser tube with water. Re-assemble and re-install vacuum break, making sure to add water to correct level (see Figure 6-3).

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 4-4).

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.

TROUBLE SHOOTING**CHAPTER 9****AIR PREPARATION**

PROBLEM/SYMPTOM	POSSIBLE CAUSE	SOLUTION
Unit not operating	<ul style="list-style-type: none"> - No power to system - Power switch in “OFF” position - Incorrect wiring 	<ul style="list-style-type: none"> - Check main power to system - Turn switch to “ON” position - See “Installation Procedures – Electrical”
Low air flow or no air flow	<ul style="list-style-type: none"> - Flow meter out of adjustment - Fouled compressor inlet filter - Compressor not functioning 	<ul style="list-style-type: none"> - Adjust flow meter See “Start-Up & Calibration-Step 5” - Replace inlet filter - Rebuild or replace as required
Compressor pressure relief valve making noise	<ul style="list-style-type: none"> - Pressure relief valve not operating - Excessive backpressure in system - Pinched tubing - Compressor not functioning - ATF not operating 	<ul style="list-style-type: none"> - Replace pressure relief valve - Check check valve for proper operation, replace as required. - Replace tubing - Rebuild or replace as required - Repair or replace ATF as required
Indicator cartridge desiccant has changed from blue & white to all pink or white	<ul style="list-style-type: none"> - Moisture has entered air prep system 	<ul style="list-style-type: none"> - Check & tighten fittings - Rebuild/replace compressor or ATF module as required - Replace indicating desiccant
Unit is making excessive noise	<ul style="list-style-type: none"> - Unit not properly secured to floor - Shipping damage - Fan blocked - Packaging material not removed 	<ul style="list-style-type: none"> - Place unit on a flat level surface - Locate damage and repair/replace parts - Clear obstructions - Remove packaging material

OZONE GENERATOR

PROBLEM/SYMPTOM	POSSIBLE CAUSE	SOLUTION
“Main Power” light is not illuminated or System is not “ON”	<ul style="list-style-type: none"> - Lamp burned out - No power to unit - Switch is in the “OFF” position - Blown fuse - Incorrect wiring 	<ul style="list-style-type: none"> - Replace light - Check circuit breakers - Turn switch to the “ON” position - Replace fuse - See “Installation Procedures - Electrical”
Circuit breaker trips	<ul style="list-style-type: none"> - Incorrect wiring - Circuit breaker amperage does not match 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
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

OZONE GENERATOR – continued

PROBLEM/SYMPTOM	POSSIBLE CAUSE	SOLUTION
Drive Module - Main Power “Green” LED(s) not illuminated	<ul style="list-style-type: none"> - No power to drive module from power supply - LED is not illuminated during startup sweep. - Blown drive board module on board fuse 	<ul style="list-style-type: none"> - Check main power to unit - Test voltage from power supply to drive module (see “Appendix – Drive Module Input Voltages”) - Check for loose wires or connectors - Turn contact signal up (POT or 4-20) to let unit complete startup sweep. - Replace “on board” fuse
Transformer (XFMR) Power, “Green” LED not illuminated	<ul style="list-style-type: none"> - If drive module “Main Power” LED(s) not illuminated, the “XFMR Power” LED will not illuminate - No power to drive module from power supply 	<ul style="list-style-type: none"> - Test voltage from power supply to drive module (see “Appendix–Drive Module Input Voltages”) - Check main power, check for loose wires or connectors
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 is turned down to 0% - Drive board is in “Fault” mode 	<ul style="list-style-type: none"> - Check all wires and connectors - Turning the Manual Ozone Output knob clockwise will increase ozone output percentage and the “Ozone Output” LED will begin to illuminate (see “Installation Procedures - Electrical, Optional Equipment”) - See Troubleshooting, “Fault” LED
The “Ozone Output” LED(s) not responding to the remote 4-20mA control signal	<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”
Fault, “Red” LED illuminated With 1 or 2 Blinks every second	<ul style="list-style-type: none"> - 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 	<ul style="list-style-type: none"> - Check all wires and connectors - Replace drive board - Replace drive transformer - Replace dielectric - Clean dielectric and replace O-rings reaction chamber - Clean dielectric and replace O-rings - Attach High Voltage lead to transformer
Fault, “Red” LED illuminated With 1 or 2 Blinks every second	<ul style="list-style-type: none"> - Unit is over heating 	<ul style="list-style-type: none"> - Check fan for proper operation and clean fan filter - Check operating temperature - See “Installation Procedures - Getting Started...Equipment Placement”
Fan not operating	<ul style="list-style-type: none"> - Fan obstructed - Power supplies not operating - Fan inoperable 	<ul style="list-style-type: none"> - Remove obstruction - Check main power, check fuses. Repair or Replace as required - Replace fan
Low air flow or no air flow	<ul style="list-style-type: none"> - Air prep system not operating properly - Fouled inline filter - Air leak - Incorrect wiring to air prep system 	<ul style="list-style-type: none"> - See “Start Up & Calibration” - Step 5 - Change inline filter - Check all fittings, tighten as needed - See “Installation Procedures - Electrical”

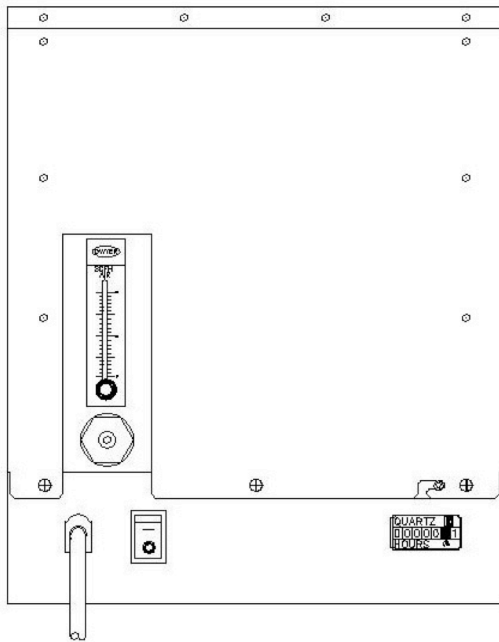
OZONE GENERATOR – continued

PROBLEM/SYMPTOM	POSSIBLE CAUSE	SOLUTION
Unit flooded with water Ozone smell detected in or ozone generator	<ul style="list-style-type: none"> - Defective check valve - Insufficient vacuum at venturi - Loose internal fittings - Defective O-ring seals in reaction chamber(s) - Defective dielectrics 	<ul style="list-style-type: none"> - Replace check valve(s) - Assess damage, repair as required near - Adjust injector See “Start- Up & Calibration - Steps 1-4” - Check all fittings, tighten as needed - Check & replace as required - Check & replace as required

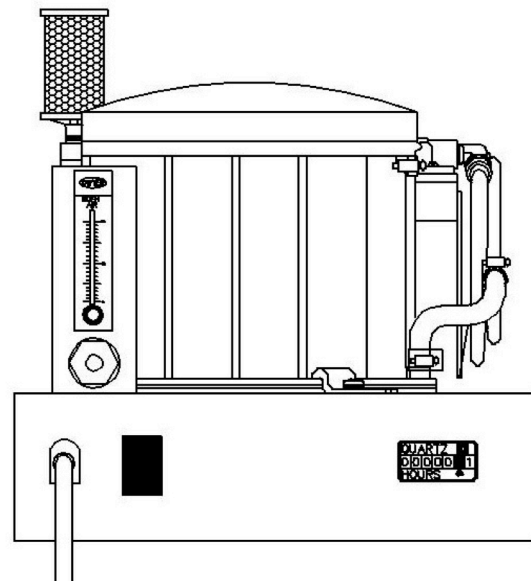
OZONE INJECTION/CONTACTING

PROBLEM/SYMPTOM	POSSIBLE CAUSE	SOLUTION
Water backflow past injector check valve	<ul style="list-style-type: none"> - Defective check valve 	<ul style="list-style-type: none"> - Replace check valve
Water bubbling in vacuum break	<ul style="list-style-type: none"> - No vacuum - Debris on seat of vacuum break flapper valve 	<ul style="list-style-type: none"> - See “Start-Up & Calibration” - Clean seat of flapper. See “Maintenance Procedures - Annual”
Low vacuum	<ul style="list-style-type: none"> - Hydraulics/Pneumatics out of adjustment - Defective check valve - Hydraulic back pressure - Check for obstruction in venturi - Defective solenoid valve - No water in vacuum break - Booster pump not functioning properly 	<ul style="list-style-type: none"> - See “Start-Up & Calibration - Steps 1-4” - Replace check valve - Back wash filter (if so equipped) - Rebuild or replace as required - Fill vacuum break with water See “Start-Up and Calibration – Vacuum Break” - Check booster pump (contact dealer)
High Vacuum	<ul style="list-style-type: none"> - Hydraulics/Pneumatics out of adjustment - Change in hydraulics – excessive water flow through ozone injector 	<ul style="list-style-type: none"> - See “Start-Up & Calibration – Steps 1-4” - See “Start-Up & Calibration – Steps 1-4”
Ozone smell detected around vacuum break or ozone injector	<ul style="list-style-type: none"> - No vacuum - Loose fittings - Broken fittings 	<ul style="list-style-type: none"> - See “Start-Up & Calibration – Steps 1-4” - Tighten all fittings - Replace fittings

Specifications



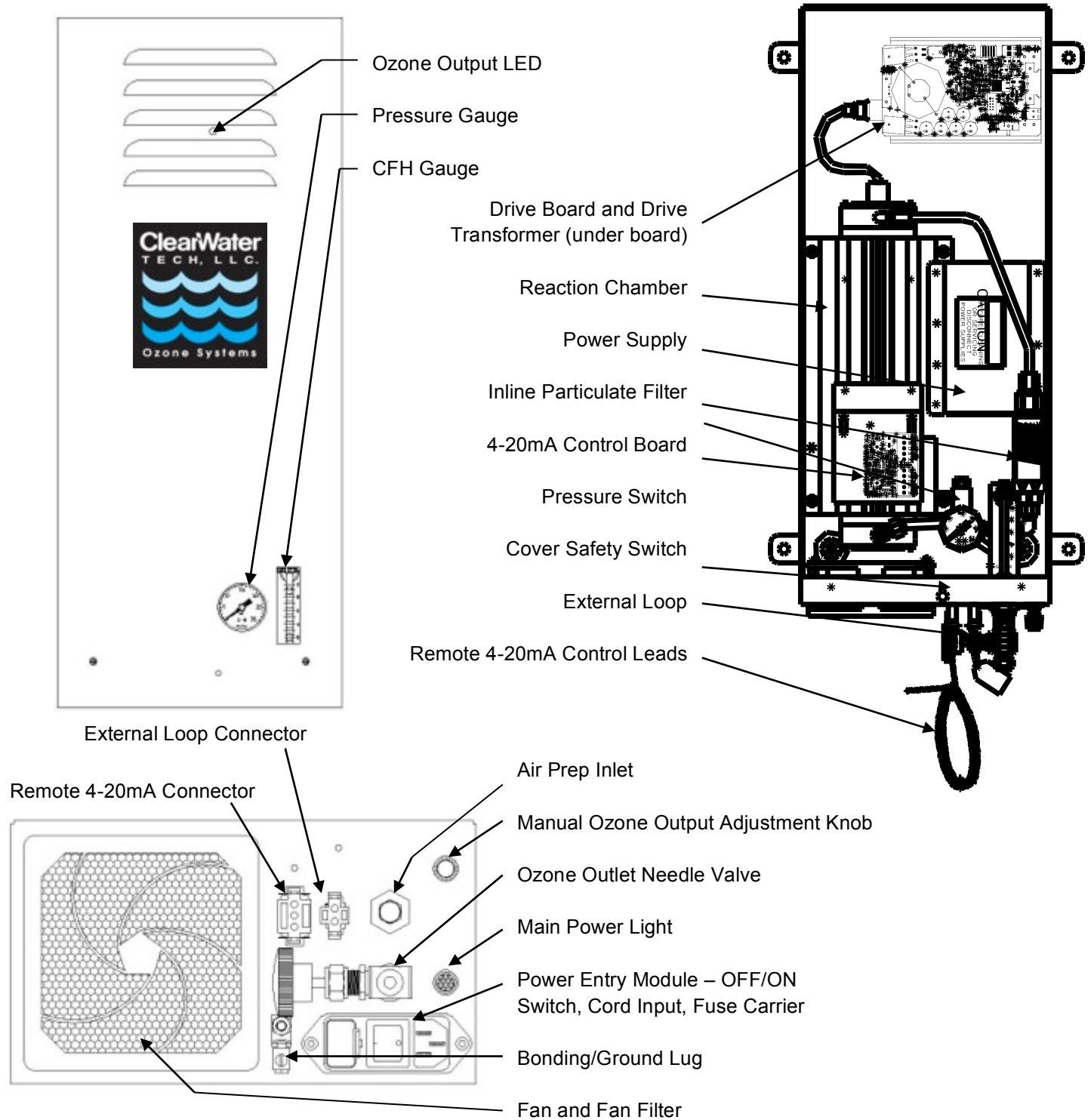
Shown: ClearWater Tech OXS90 Air Prep System with Cover



Shown: ClearWater Tech OXS90 Air Prep System with out Cover

AIR PREP SYSTEM	SPECIFICATIONS	OXYGEN OUTPUT/SCFH
<p align="center">OXS90 (Workhorse 12c)</p>	<p align="center">15.5" h x 17" w x 16" d, 45 lbs (with cover)</p>	<p align="center">90% (+/-3%) @ 12 scfh, 12PSI</p>

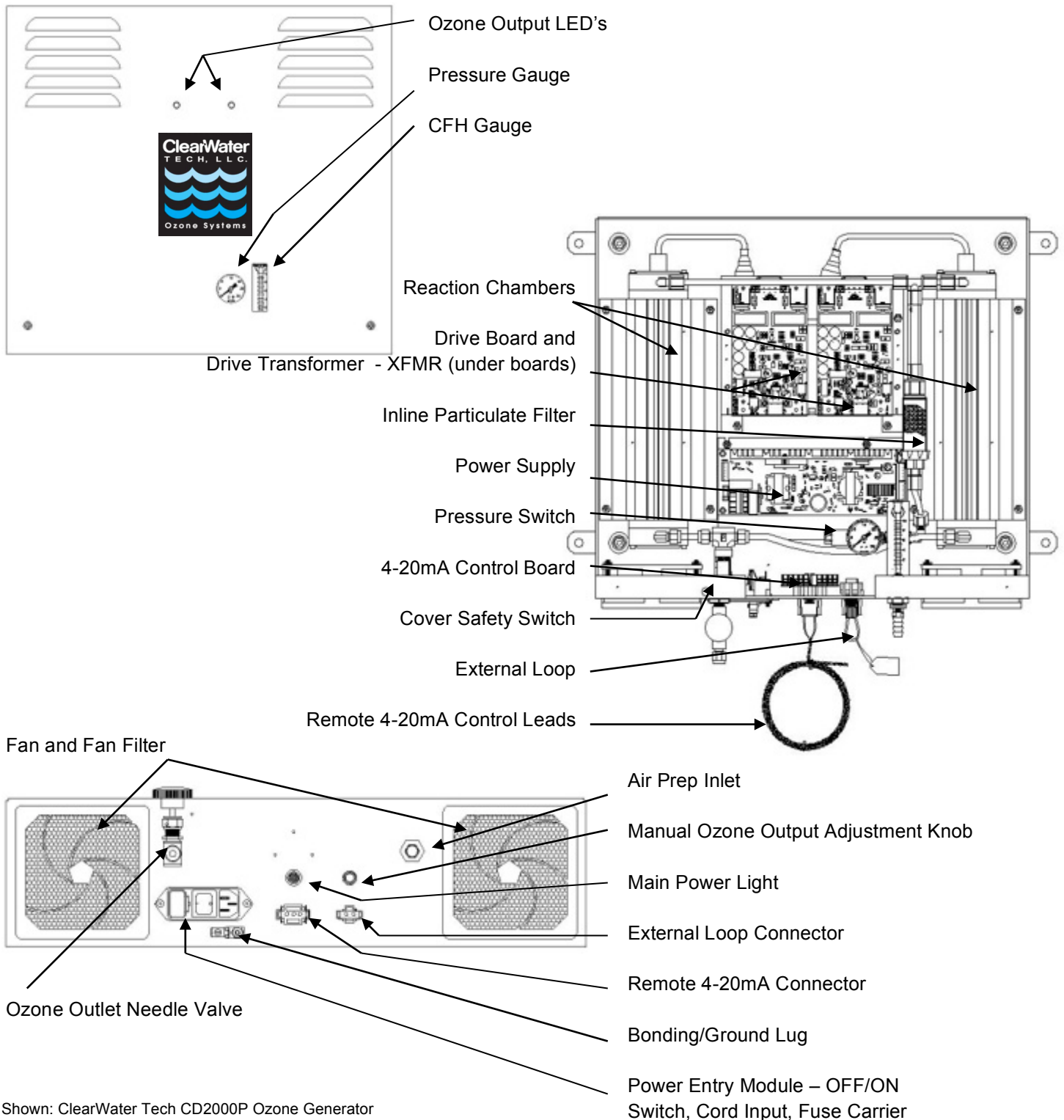
Section A – Specifications



Shown: ClearWater Tech CD1500P Ozone Generator

OZONE GENERATOR	SPECIFICATIONS	OZONE OUTPUT/SCFH
CD1500P	27" h x 9.25" w x 5.5" d, 32 lbs	15g/h, 6% @ 6 scfh, 10PSI PSA Oxygen
Mounting Hole Measurement	17.75" h x 10.50" w	

Section A – Specifications



Shown: ClearWater Tech CD2000P Ozone Generator

OZONE GENERATOR	SPECIFICATIONS	OZONE OUTPUT/SCFH
CD2000P	23" h x 20.25" w x 5.5" d, 49 lbs	26.5g/h, 6% @ 12 scfh, 10PSI PSA Oxygen
Mounting Hole Measurement	13.50" h x 21.75" w	

APPENDIX - Section B

Parts List

Air Preparation

Description	OXS90
Compressor Inlet Filter	OXS350
Compressor Rebuild Kit	OXS356
Pressure Relief Valve	OXS361
Compressor Vibration Mount	OXS365
Indicating Desiccant Refill – (if so equipped)	DES16

Ozone Generator

Description	CD1500P CD2000P
Reaction Chamber – Complete CD1500P	RCC9
Reaction Chamber – Complete CD2000P	RCC10
Dielectric Anode 2"	RCC71
Non-High Voltage End Cap	Contact Dealer
High Voltage End Cap	Contact Dealer
O-ring Set	ORS40
Drive Module – Complete CD2000P	DRM60
Drive Module Transformer	HVT275
Drive Module Board	CCA1231
Power Supply – 48VDC, 130w, CD1500P	PSR812
Power Supply – 48VDC, 300w, CD2000P	PSR822
Cooling Fan – 24VDC	FA46
Cooling Fan Filter	FA40
4-20mA Control Board	ELPC5430
Inline Particulate Filter	FLT34
Pressure Switch	PS20
Fuse, Bussmann MDL-5 – 5 amp, 250VAC Slow Blow, Main Power	FUS20
Fuse, Littelfuse Minifuse 297005 - 5 amp, 32VAC, Drive Board	FUS75

APPENDIX - Section C

Maintenance Kit

Air Preparation System

ASP80 - Maintenance Kit – OXS90 air preparation system

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
OXS370	1	Oxygen Concentrator – Replacement Cover Filter

Ozone Generators

ASPM246A - Maintenance Kit – CD1500P ozone generator

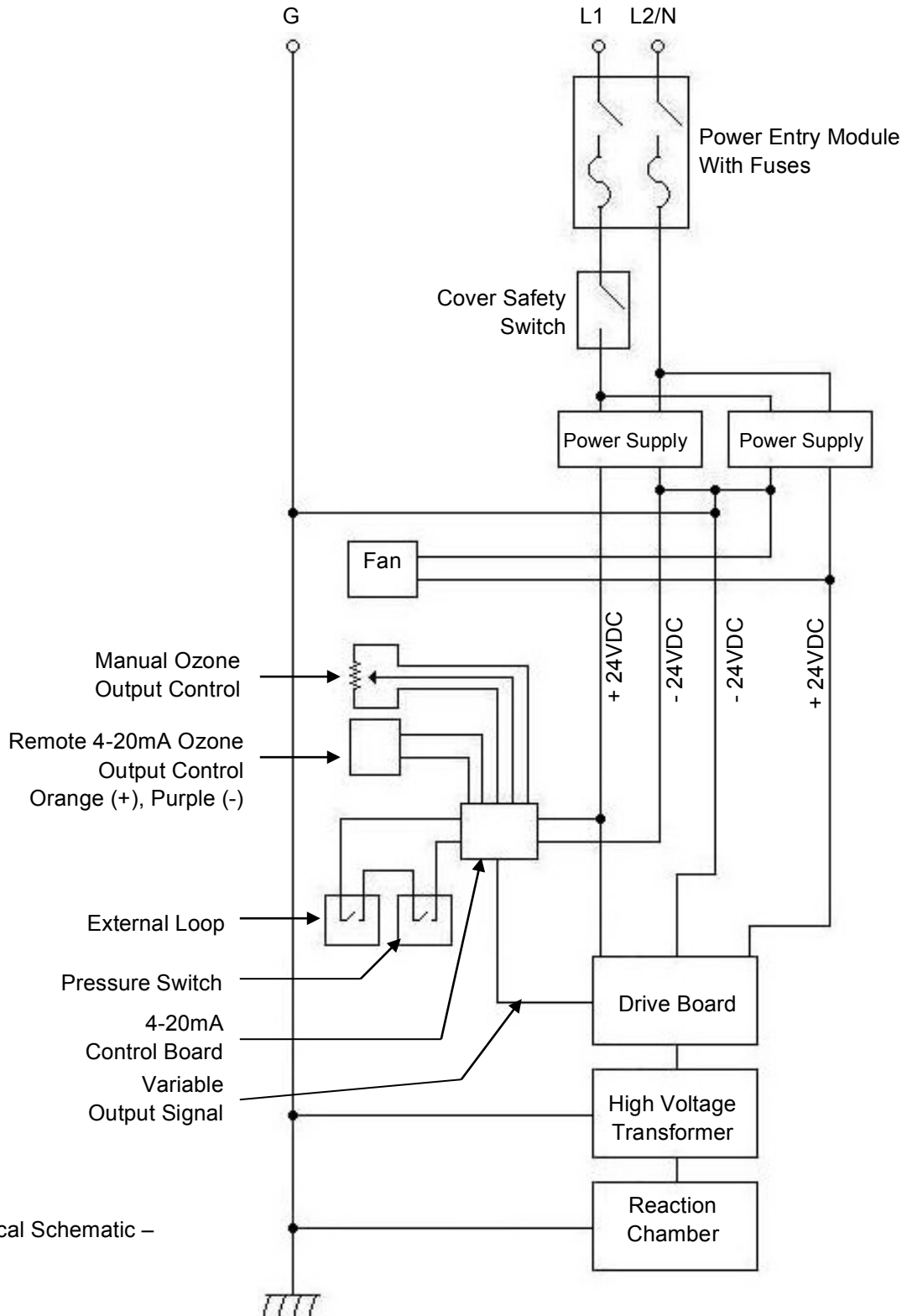
Part #	QTY	Description
FA40	1	Filter – Fan filter, element only
FLT34	1	Filter – Inline particulate filter
FUS20	2	Fuse, Bussmann MDL-5 – 5 amp, 250VAC Slow Blow, Main Power
ORG110	4	O-ring – 2” CD reaction chamber, pressurized end cap, large
ORG120	4	O-ring – 2” CD reaction chamber, pressurized end cap, small
HSW100	2	Sealing washer - Viton
HWW9004	2	Hardware washer - #6, flat, S.S.

ASPP246A - Maintenance Kit – CD2000P ozone generator

Part #	QTY	Description
FA40	2	Filter – Fan filter, element only
FLT34	1	Filter – Inline particulate filter
FUS20	2	Fuse, Bussmann MDL-5 – 5 amp, 250VAC Slow Blow, Main Power
ORG110	8	O-ring – 2” CD reaction chamber, pressurized end cap, large
ORG120	8	O-ring – 2” CD reaction chamber, pressurized end cap, small
HSW100	4	Sealing washer - Viton
HWW9004	4	Hardware washer - #6, flat, S.S.

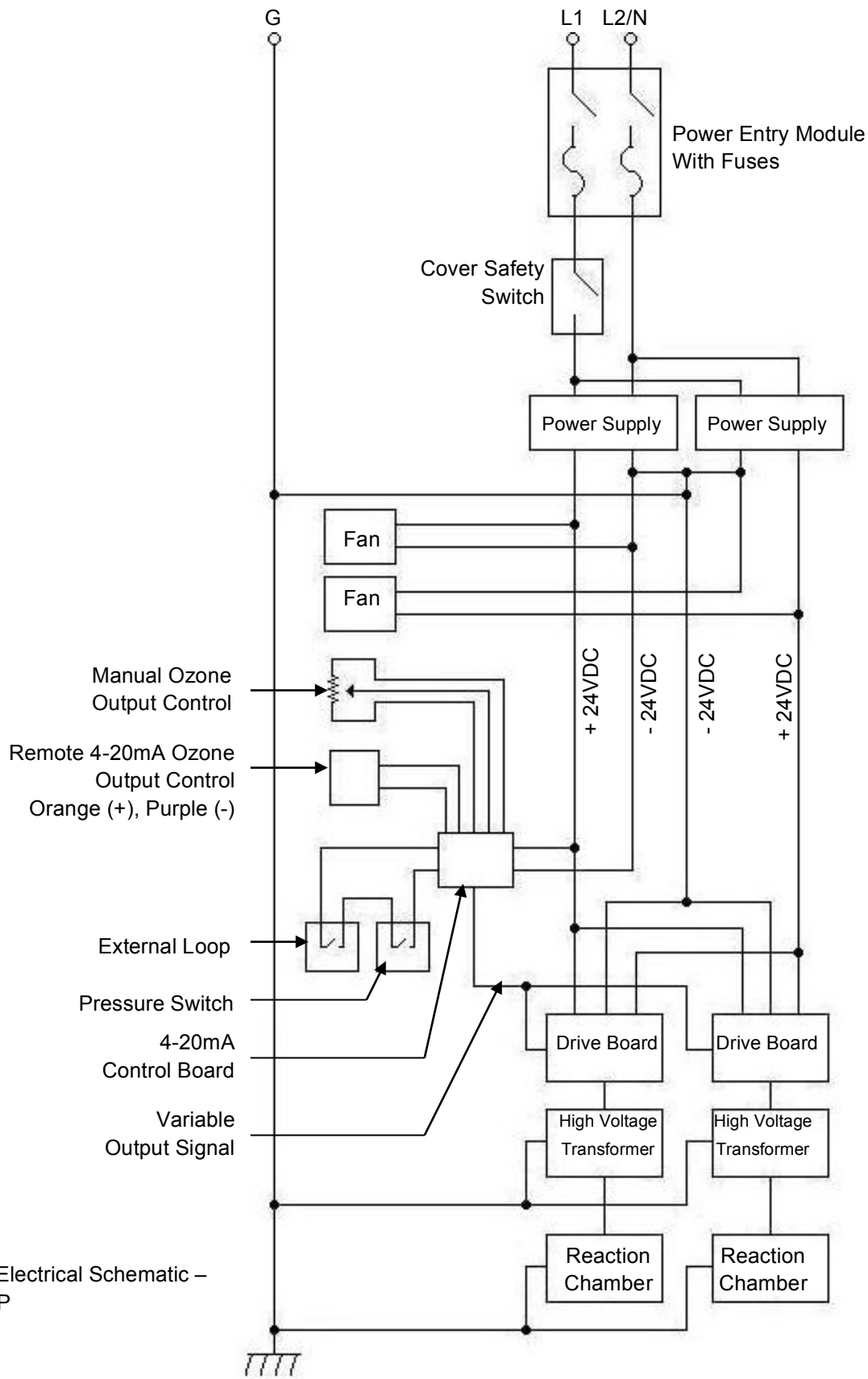
APPENDIX - Section D

Logic Schematics – CD1500P



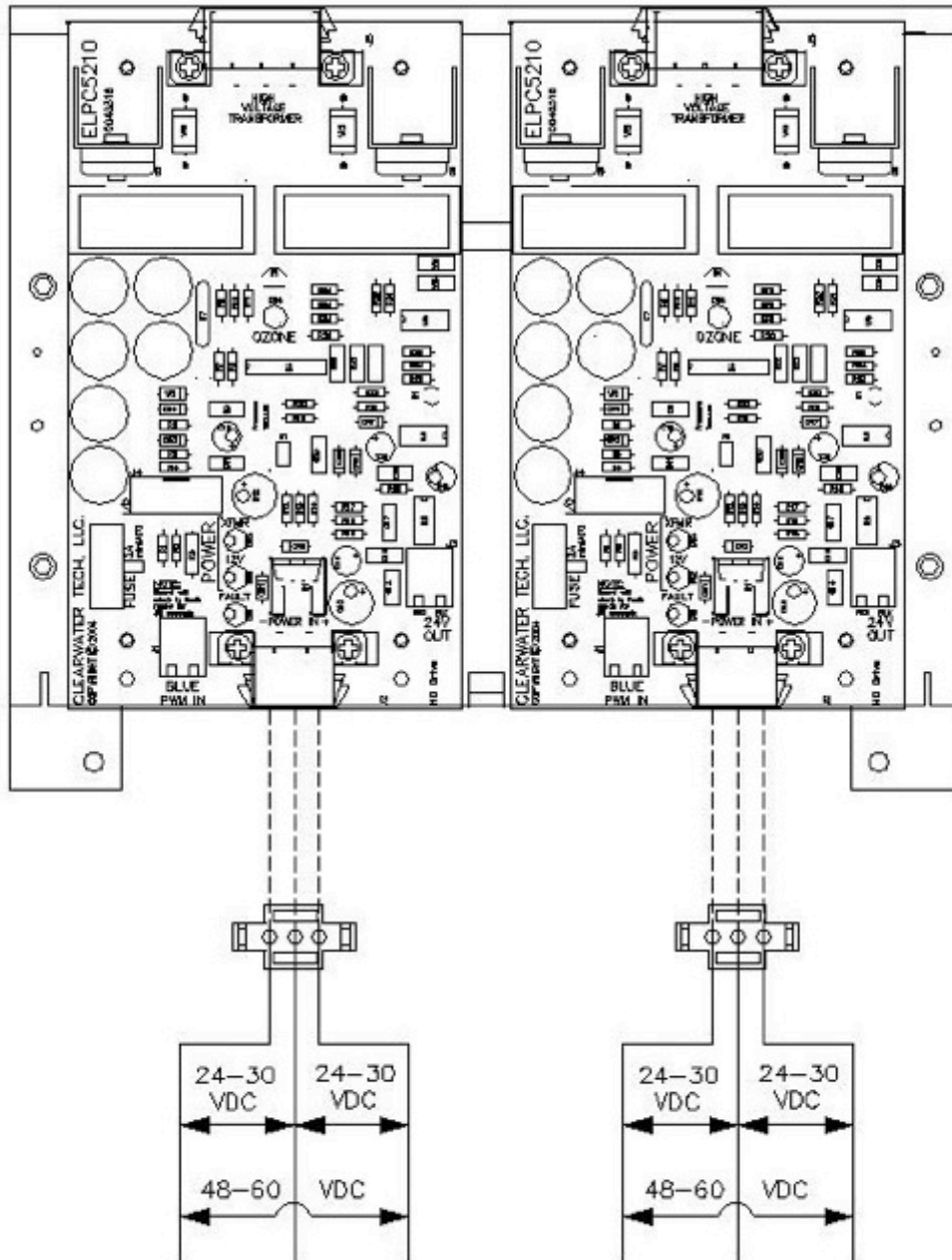
Shown: Electrical Schematic –
CD1500P

Logic Schematics – CD2000P



Shown: Electrical Schematic – CD2000P

Drive Module Input Voltages



Shown: Dual HO Drive Module

APPENDIX - Section E

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.