



Ozone System

Installation and Owner's Manual

RK4G W/ O2

RK1000MG

RK8G W/ O2

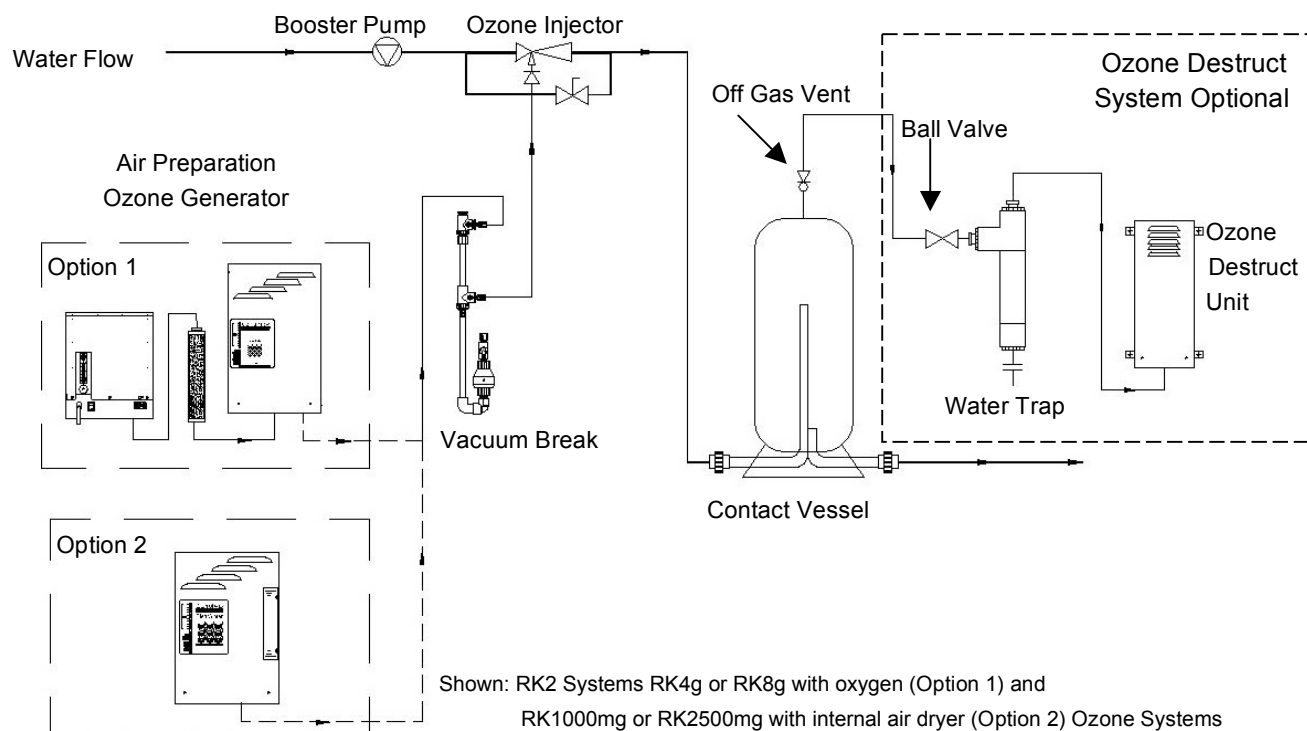
RK2500MG

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THEORY OF OPERATION/PRODUCT DESCRIPTION**CHAPTER 1**

RK2 Systems ozones are designed for safe, effective use in a variety of water treatment applications. The RK4g w/ O₂ and RK8g w/ O₂ ozone generators have been tested and certified by the Water Quality Association according to NSF/ANSI 50. Each complete, integrated system may include the 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

RK2 Systems corona discharge ozone generators require a source of clean, dry, oil-free, oxygen-enriched or dry air for effective ozone production. To meet that need, RK2 Systems can provide any one of three types of air preparation systems.

- The first type combines pressure swing adsorption (PSA) oxygen 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 PSA system is rated with a continuous duty cycle in conditions up to 90% relative humidity non-condensing.
- The second type is low pressure swing adsorption (LPSA) dry air technology which operates in the same way as the PSA oxygen system but only delivers 20% oxygen purity at -60 to -90°F dew point. The LPSA system is rated with a continuous duty cycle in conditions up to 90% relative humidity non-condensing.
- The third type is a heat regenerative dry air system. The heat regenerative system operates via a vacuum which draws in ambient air and dries it to a -10 to -20°F dew point at 20% oxygen purity. The RK1000mg and RK2500mg (“AD” represents Air Dryer) incorporate a heat regenerative air dryer system, rated with a duty cycle of no more than 10 hours of operation in a 24 hour period in conditions up to 75% relative humidity non-condensing. Due to the operation of the internal air dryer, continuous power must be applied to the 1000mg/AD and 2500mg/AD for proper

Theory of Operation/Product Description (continued)

operation. As the ambient air travels through the dryer chambers the sieve material inside traps the moisture from the air and allows the oxygen to pass to the ozone reaction chamber. The heat, generated by the heating rods inside the dryer chamber, then evaporates the moisture that has been trapped in the sieve and expels off the top of the sieve bed. The two dryer chambers and attached 3-way solenoid valve operate on a timed cycle. Dryer chamber 1 heats first evaporating moisture for 1-1/2 hours, while the solenoid is energized allowing the vacuum from the venturi to draw air flow through dryer chamber 2. During this time the “AIR PREP” LED will flash and “DRYER 1” LED will be illuminated continuously. After the 1-1/2 hours there is a 1/2 hour cool down period, power to dryer chamber 1 will be discontinued, correspondingly “DRYER 1” LED will not be illuminated. **Note: The “AIR PREP” LED will remain flashing throughout the cycle.** After the cool down period dryer chamber 2 will heat and the solenoid valve will de-energize, allowing vacuum from the venturi to draw air flow through dryer chamber 1. During this time the “AIR PREP” LED will flash and “DRYER 2” LED will be illuminated continuously. After 1-1/2 hours there is a 1/2 hour cool down period when power to dryer chamber 2 will be discontinued; correspondingly, “DRYER 2” LED will not be illuminated. After this 1/2 hour cool down, the air dryer cycle will repeat.

If “Plant Air” feed gas is to be used in place of a RK2 Systems 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 5 PSI.

The type of air preparation will effect 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, producing more grams per hour and concentration of ozone. Since a PSA oxygen concentrator has an oxygen output that is nearly four and a half times greater than a standard air dryer, it will yield the highest grams per hour with 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

The feed gas produced by the either the PSA or LPSA air preparation system is supplied to the RK2 Systems ozone generator at a maximum pressure of 5 pounds per square inch (PSI). **Note: If a heat regenerative air dryer is used the feed gas will be at drawn through the ozone generator under vacuum.** An external air flow meter and vacuum gauge is recommended to be used to control and monitor the air flow and vacuum through the ozone generator. At this point, the feed gas is drawn through the ozone generator by the vacuum created at the ozone injector rather than by the pressure from the air preparation system compressors.

As the feed gas enters the 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 (O_1). These oxygen atoms then recombine with other oxygen molecules in the air stream, forming ozone.

Depending on the application, the RK2 Systems ozone generator may be interlocked with an oxidation reduction potential (ORP) or parts per million (PPM) controller, pressure switch flow switch, timer, or circulation pump. Many safety features are also built in, including main power fuses, thermal protection, cover safety switch, and back flow prevention.

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.

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!



RK2 Systems 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 RK2 Systems 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 RK2 Systems off-gas destruct systems consist 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 RK2 Systems 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.

SAFETY WARNINGS

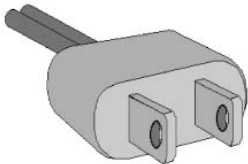
Two aspects of RK2 Systems ozone generators represent potential dangers: ozone gas and high voltage electricity.

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 RK2 Systems corona discharge ozone generators are designed to operate under a vacuum 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: RK2 SYSTEMS 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.



RK2 Systems 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. Warning: For indoor use only. This unit is not intended for outdoor use.**
- 3. Install at least 5ft from tub water using nonmetallic plumbing. Install ozone generator no less than 1 ft above the maximum water level to prevent water from contacting electrical equipment. Install in accordance with the installation instructions.**
- 4. Warning: Short term inhalation of high concentration of ozone and long term inhalation of low concentrations of ozone can cause serious harmful physiological effects. Do not inhale gas produced by this device.**
- 5. At least two lugs marked “BONDING LUGS” are provided on the external surface or on the inside of the supply terminal box or compartment. To reduce the risk of electrical shock, connect the local common bonding grid in the area of the hot tub or spa to these terminals with an insulated or bare copper conductor not smaller than No. 6 AWG.**
- 6. All field-installed metal components such as rails, ladders, drains or other similar hardware within 3m of the spa or hot tub shall be bonded to the equipment grounding bus with copper conductors not smaller than No. 6 AWG.**
- 7. All electrical connections should be made by a licensed, qualified electrician.**
- 8. Before attempting any electrical connections, be sure all power is off at the main circuit breaker.**
- 9. CAUTION: THE EQUIPMENT AND CONTROLS SHALL BE LOCATED NOT LESS THAN 1M HORIZONTALLY FROM THE SPA OR HOT TUB**
- 10. 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.**
- 11. 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.**
- 12. Connect to a grounded, grounding type receptacle only.**
- 13. Do not bury cord.**
- 14. Warning – To reduce the risk of electrical shock, replace damaged cord immediately.**
- 15. Before attempting any electrical connections, be sure all power is off at the main circuit breaker.**
- 16. Install check valves and a vacuum break to prevent water from contacting the electrical equipment.**
- 17. SAVE THESE INSTRUCTIONS.**

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 the 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 (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).
 - 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. **Warning: 0 - 75% relative humidity, non-condensing environment, must be observed for any heat regenerative air dryer.**
 - 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 the 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(s) 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 side stream 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. RK2 Systems contact columns and the 30, 40, 80, and 120-gallon contact tanks have inlet *and* outlet fittings on the bottom of the vessel(s) 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.

Plumbing (continued)

- 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 RK2 Systems contact column, use a RK2 Systems 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 RK2 Systems 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.

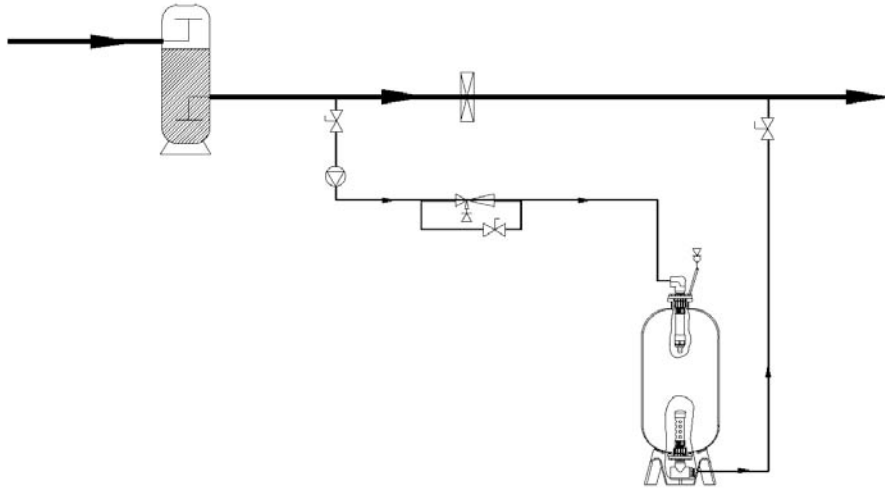
Step 3: Cut the unistrut bar to the desired length and attach it to the 'L' bracket using hardware provided.

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.

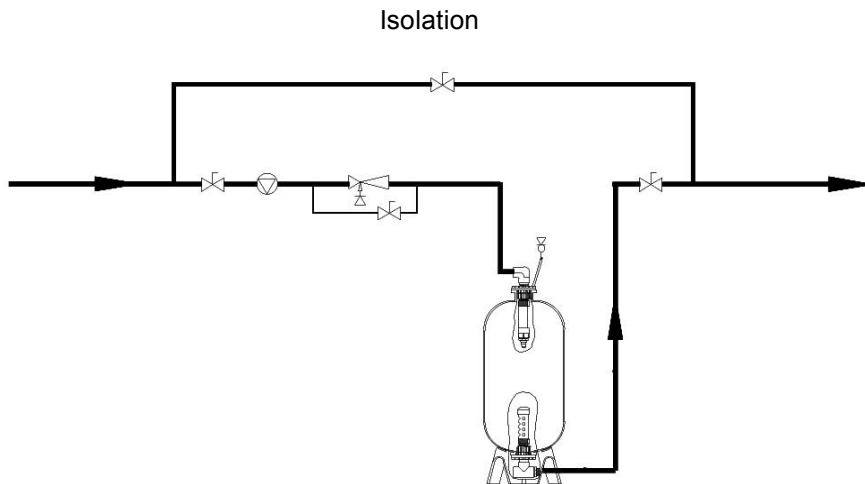
Sidestream Plumbing Installation Diagram

Figure 4-1



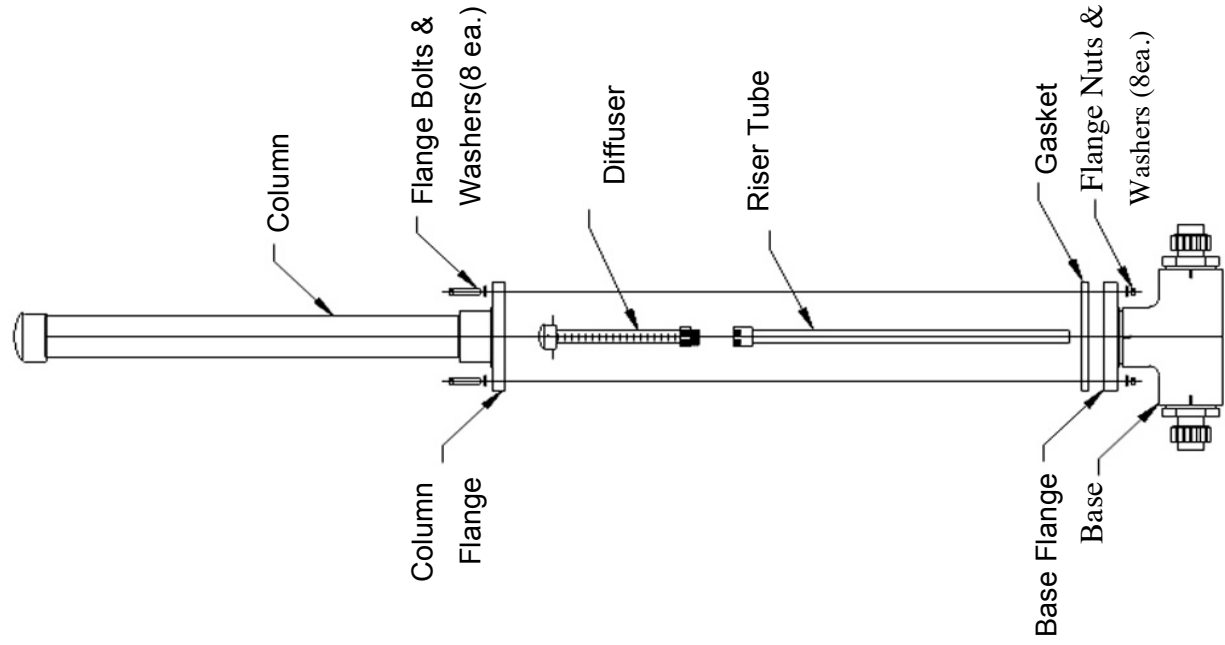
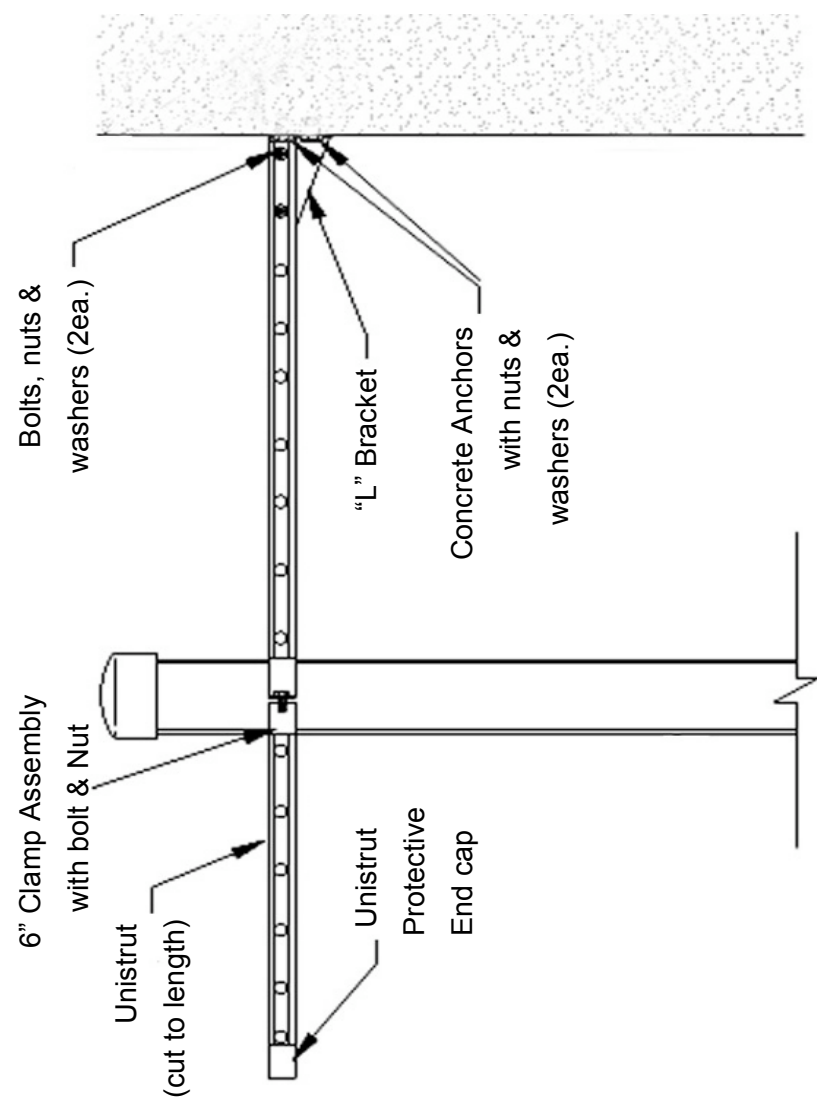
Full Flow Plumbing Installation Diagram

Figure 4-1



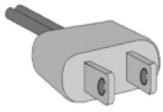
Contact Column Installation Diagram

Figure 4-3



Contact Column Exploded View

Figure 4-4



The RK1000mg Series ozone generators are equipped with universal regulated power supplies that accept an input voltage from 90-250VAC at 47-63Hz, single phase (1 ϕ). RK2 Systems 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.

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.
- The RK1000mg and RK2500mg must be energized by a constant unswitched power source for proper operation of the on-board heat regenerative dry air system.
- The air flow of the RK1000mg and RK2500mg must not be drawn through the unit for more than 10 hours in a 24 hour period for proper operation of the on-board air dryer.

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 #6 AWG) from the copper-bonding lug located on the bottom of the ozone generator to the grounding point.

Step 2: Main Power: Plug in the IEC end of the power cord to 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. **Note:** The 1000mg/AD and 2500mg/AD must be energized by a constant unswitched power source.

1000mg Series Power Consumption	
Input Voltage	90-250VAC 47-63Hz
RK4g w/ O ₂	1.1 - 0.4 amps
RK1000mg	2.2 - 0.8 amps
RK8g w/ O ₂	1.5 - 0.6 amps
RK2500mg	3.5 - 1.8 amps

Step 3: External Loop (EXT LOOP): The external loop, noted on the front cover LED display as “EXT LOOP”, is a true dry contact interface. **Note:** The term ‘dry contact’ means that this loop does not supply output nor accept 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 “EXT LOOP” LED 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 and the internal air dryer of the RK1000mg. When continuity is present through the external loop ozone, output will continue. This continuity will effectively turn “OFF” the “EXT LOOP” LED 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 RK2 Systems 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 1000mg Series ozone generators are equipped with two options for controlling the ozone output. The first is a manual 0-100% ozone output control and the second option 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 to down 0%, while turning the knob clockwise will increase the ozone output up to 100%. The percent of ozone output is indicated by the “Ozone Output” LEDs on the front of the ozone generator, with each LED representing 10% output (see Figure 7-1).
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 percent of ozone output is indicated by the “Ozone Output” LEDs on the front of the ozone generator, with each LED representing 10% output (see Figure 7-1). **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.**

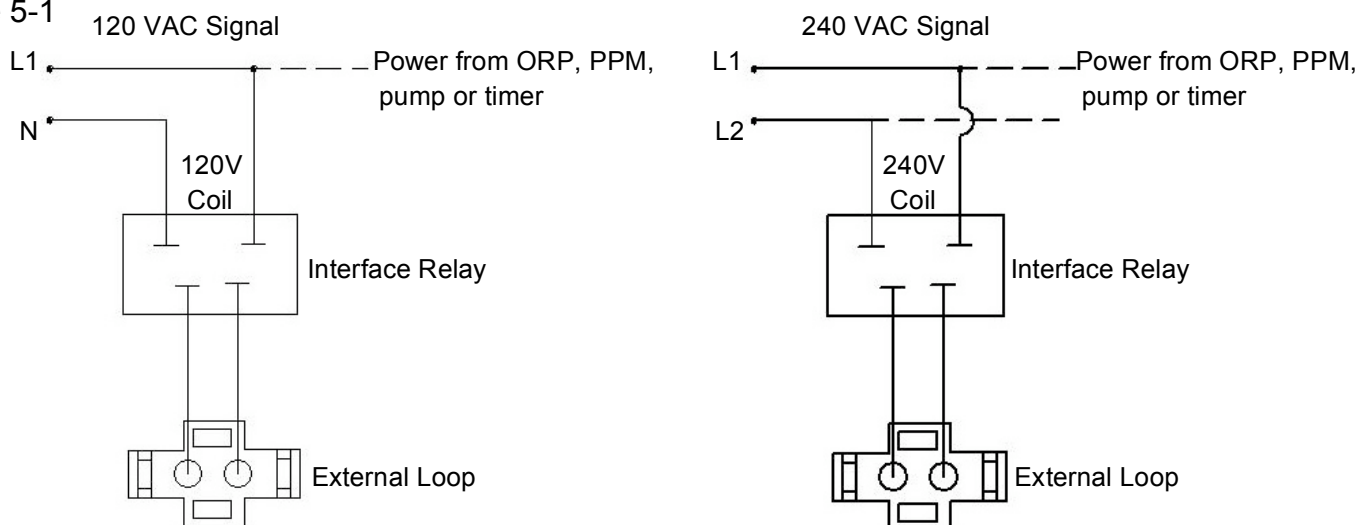
- Step 1:** Mount the 4-20mA controller to a suitable vertical surface according to the installation manual supplied with the controller.
- Step 2:** Wire the #22 AWG orange “positive” (+) lead from the ozone generator to the 4-20mA controller according to the manual supplied with the controller.
- Step 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 - RK4g and RK8g w/ O2 only: 120VAC systems only: if a PSA oxygen concentrator LPSA dry air system is used, plug power cord into main power. 240VAC systems only: if a PSA oxygen concentrator or LPSA dry air system is used, the power cord must be hard wired to the main power source (Black-L1, White-L2 and Green-Ground). **Notes:** The prescribed air flow must be set to “atmospheric pressure” on either the PSA oxygen concentrator or LPSA dry air system prior to use. Follow Step 4 of the “Start-up & Calibration” section. **Warnings:** Failure to calibrate may lead to premature failure of the air preparation systems. Vacuum must be interrupted if the air prep system is not “ON.” Failure to do so will damage the air prep system.

Air Preparation System - RK1000mg only: The air dryer of the RK1000mg is powered by the main power of the unit.

External Loop Electrical Interface

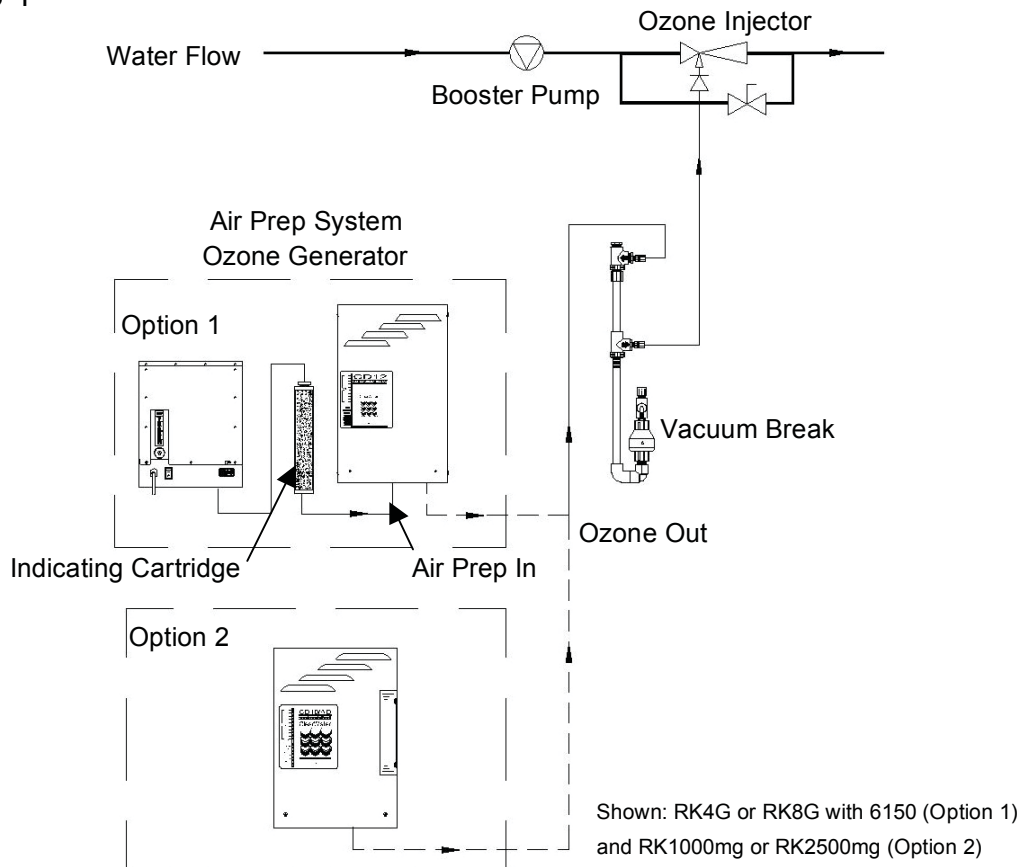
Figure 5-1



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 oil-free oxygen-enriched air (90% +/- 3% oxygen purity at -100°F dew point) or dry air (20% oxygen purity). 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.

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

Figure 6-1



• PSA Oxygen Concentrator or LPSA Dry Air - RK4G or RK8G W/ O2 only:

Step 1: Teflon® tape and attach brass barb provided to the PSA oxygen concentrator or LPSA dry air 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 oxygen concentrator or LPSA dry air 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 or LPSA dry air system to one end of the indicator cartridge. Secure the tubing to the brass fittings with the hose clamps provided.

Step 5: Air Flow Gauge Assembly: Mount the standard cubic feet per hour (SCFH)/vacuum gauge assembly to the ozone generator (ordered separately), following the installation instructions provided with the gauge assembly.

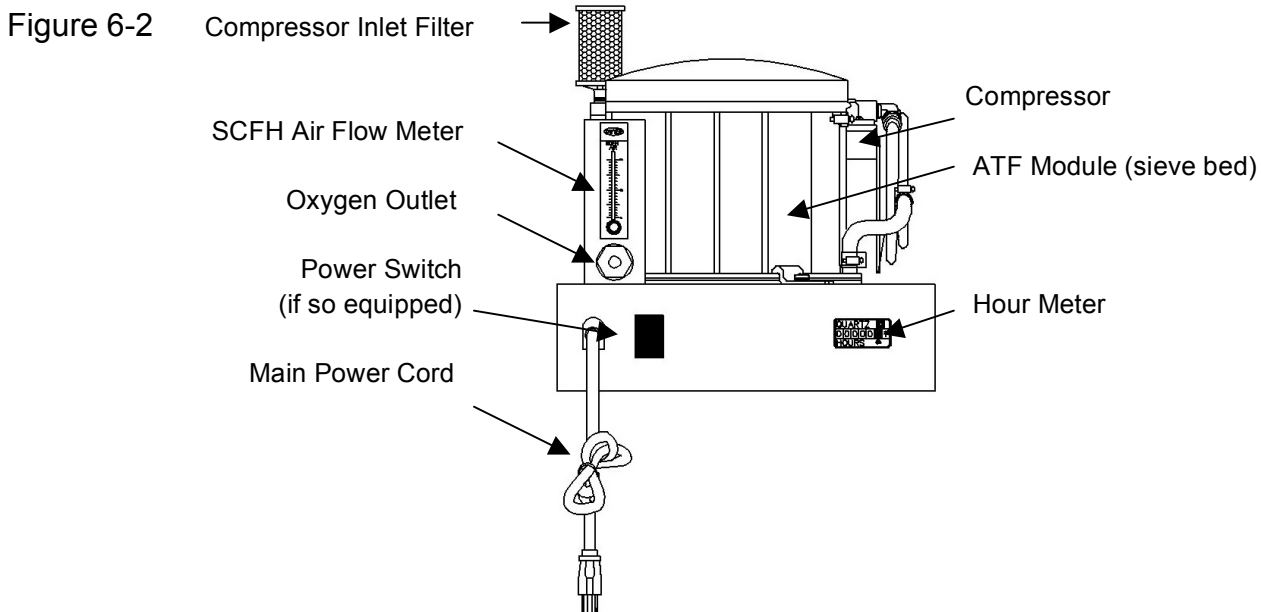
Step 6: Using a suitable length of 3/8” braided tubing attach tubing to the brass barb located at the other end of the indicator cartridge then attach the other end of the tubing to the SCFH/vacuum gauge assembly. Secure the tubing to the fittings with the hose clamps provided.

• **6113 - Heat Regenerative Dry Air - RK4G or RK8G w/O2 only:** Follow the installation procedures according to the Installation and Operation Manual provided with the 6113.

• **Heat Regenerative Dry Air - RK1000mg and RK2500mg only:** The RK1000mg ozone generator (AD represents Air Dryer) has been pneumatically pre-plumbed at the factory with an internal heat regenerative air dryer to provide simplicity of a “plug and play” ozone system. The RK1000mg and RK2500mg are also equipped with an internal moisture-indicating cartridge, which is visible through the view window on the right side of the RK1000mg and RK2500mg. This indicating cartridge is used as a reference to indicate the quality of dry air. If the air dryer is not operating properly the silica will turn from blue and white in color to all white. See Troubleshooting Guide. The RK1000mg and RK2500mg are also equipped with an “External Air Prep Loop,” which can be used to interface the SCFH/vacuum gauge assembly by following the installation instructions provided with the gauge assembly. This is the only necessary pneumatic connection. The air flow of the RK1000mg and RK2500mg must not be drawn through the unit for more than 10 hours in a 24 hour period.

The RK1000mg and RK2500mg must be powered up for 24 hours prior to system start-up (*no air flow should be drawn through the system by the ozone injection manifold*). This sieve material in the heat regenerative air dryer must be evaporated of any moisture that has accumulated. **Notes: If this step is not completed premature failure of the heat regenerative air dryer system will occur. During this time the external loop connector may be removed so that the ozone reaction chamber will not have power to it.**

Oxygen Concentrator/LPSA Dry Air Detail



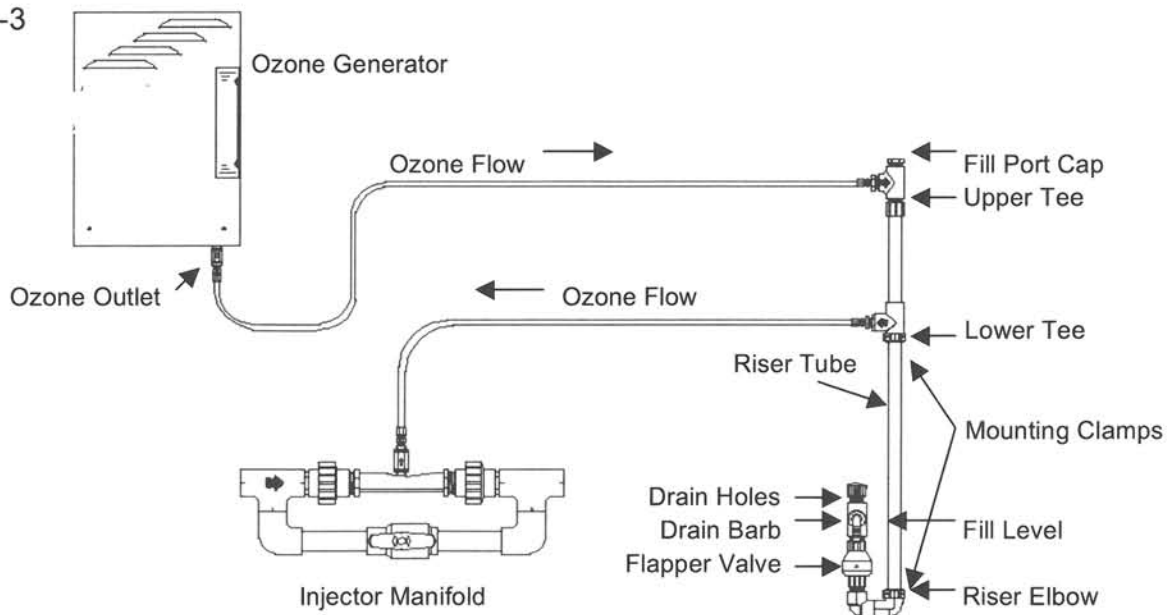
Hook-Ups: Ozone generator-to-vacuum break & vacuum break-to-injector manifold

The RK2 Systems 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.

- 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) to “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 5:** Install the check valve with compression fitting (located in the parts kit or attached to the ozone generator with a wire tie) into the stainless steel ozone outlet located at the bottom of the ozone generator.
- Step 6:** Connect one end of a suitable length of Teflon® ozone delivery line to the fittings installed into the ozone outlets (see Step 5 above). 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. Attach the other end of the delivery line to the fitting located on top of the check valve assembly, which was installed at the injector manifold.
- 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



Hook-Up: Contact vessel-to-ozone destruct system (if so equipped)

The RK2 Systems ozone off-gas destruct system 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 the RK2 Systems off-gas vent, this two-stage ozone destruct system is an efficient way to properly vent the ozone system contact vessel (see Figure 6-4).

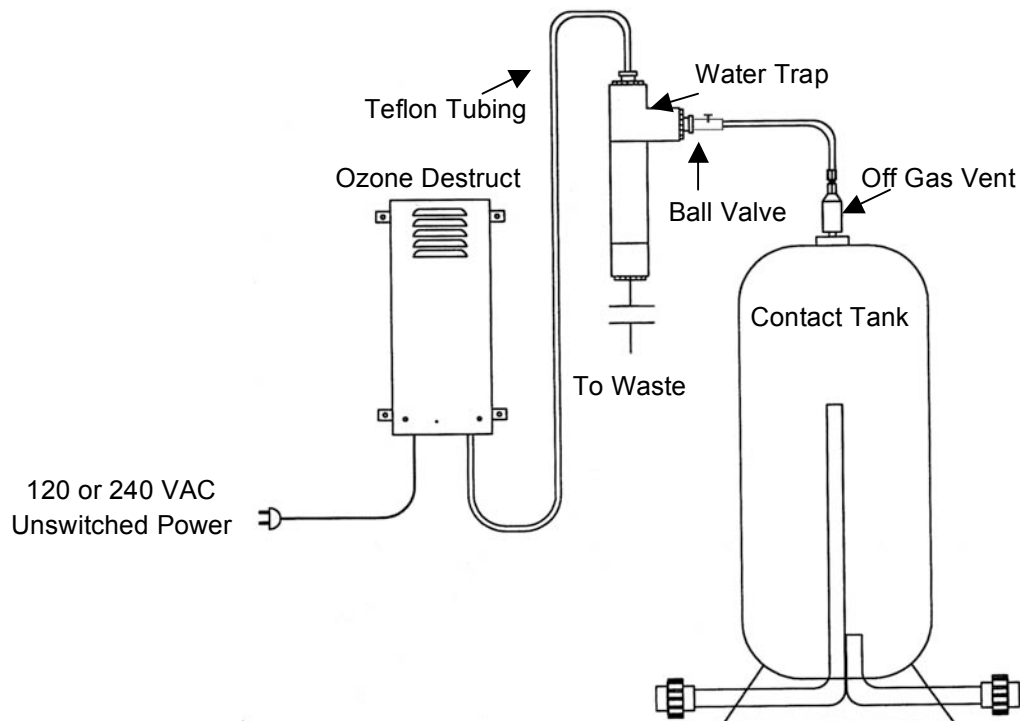
NOTES:

- The ozone destruct unit must have constant power to function properly. Make sure it is plugged into an unswitched 120VAC outlet or wired to unswitched 240VAC power. Once up to temperature, the unit will remain warm to the touch.
- It is normal for small amounts of water to drain from the water trap, so it must be plumbed to waste appropriately.

- Step 1:** Select a suitable vertical surface adjacent to the ozone system contact vessel. Using the Clic® mounting clamps provided, mount the water trap to the surface.
- Step 2:** Using the mounting tabs, mount the ozone destruct unit adjacent to the water trap.
- Step 3:** Using Teflon® tape, install the small ball valve into the opening (at the tee or inlet) of the water trap. Using Teflon® tape, install the thread-by-compression fitting provided into the small ball valve.
- Step 4:** Using the compression fitting, attach one end of a suitable length of the Teflon® tubing to the compression fitting on top of the contact vessel (the fitting is threaded directly into the cap of the contact *column* and is threaded into the off-gas vent on the top of a contact *tank*). Attach the other end of the tubing to the inlet of the small ball valve (see Step 3 above) in the water trap.
- Step 5:** Using the compression fitting provided, attach another suitable length of Teflon® tubing to the fitting on top of the water trap. Attach the other end of the tubing to the inlet compression fitting on the bottom of the ozone destruct unit.
- Step 6:** Attach a suitable length of braided tubing to the fitting on the bottom of the water trap. Terminate the other end to appropriate waste or drain.
- Step 7:** Plug the ozone destruct unit into an unswitched 120VAC outlet or wire to unswitched 240VAC power and allow it to warm up. **Warning:** The destruct unit will be warm to the touch when in operation.

Ozone Destruct System Detail

Figure 6-5



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 a slight vacuum (measured in inches of mercury, or “in.Hg”). Air from the air preparation system 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/vacuum gauge assembly mounted to the RK4G or RK8g w/O₂. **Note: If an external heat regenerative dry air system, RK1000mg or the RK2500mg is used, the air flow will be completely dependant upon the vacuum draw of the ozone injector manifold.** If the vacuum level is too high but air flow levels are correct, opening the ball valve on the injector manifold(s) slightly will decrease the vacuum by increasing the amount of water flowing through the bypass of the ozone injector manifold. Similarly, if the vacuum level is too low, closing the ball valve on the injector manifold(s) slightly will increase the vacuum.

Air Preparation System, Ozone Generator & Ozone Injector

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(s) full, off-gas vent(s) 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: Make sure electrical power to all ozone system electrical components is on. The main power switch of the air preparation system must be in the “ON” position (if so equipped; see Figure 6-2).

• **PSA Oxygen Concentrator and LPSA Dry Air:** Systems 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.”**

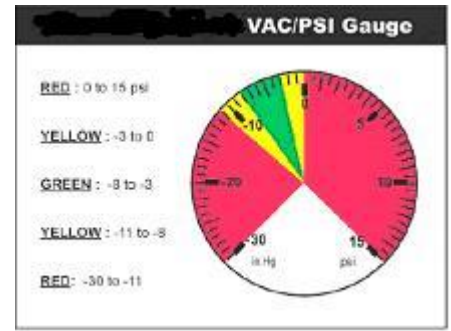
Step 1: Check to make sure the compressor of the PSA or LPSA air preparation system is operating.

Step 2: Using the air flow gauge adjustment valve on the PSA or LPSA air preparation system (see Figure 6-2), adjust the air flow according to the “air prep system air flow” specifications outlined in Figure 7-2.

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 GAGE ADJUSTMENT VALVE.

• **RK1000mg and RK2500mg:** Unit must be powered up for 24 hours prior to system start-up (*no air flow should be drawn through the system by the ozone injection manifold until this step has been completed*). The sieve material in the heat regenerative air dryer must be evaporated of any moisture that has accumulated. If the external loop has been removed during this step, replace external loop. **Note: If this step is not completed premature failure of the heat regenerative air dryer system may occur.**

Step 5: Using the RK2Systems SCFH/vacuum gauge 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 Standard Cubic Feet per Hour (SCFH) of air flow (see the “Pneumatic Operating Parameters, Ozone generator air flow,” Figure 7-2).



Step 6: Using the ball valve on the ozone injector manifold and the air flow adjustment valve on the ozone generator, make final adjustments to vacuum and air flow levels.

Step 7: 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 generator and ozone injector manifold may make a humming noise. This is normal.**

Step 8: Observe all indicating LEDs on the front cover of the ozone generator (see Figure 7-1) for proper operation and adjust the manual ozone output knob to desired level setting.

Ozone Generator LED Display

Figure 7-1

LED	Function	RK4G	RK1000MG	RK8G	RK2500MG
OZONE OUTPUT	The ten LEDs represent 0-100%, minimum to maximum ozone output. Each LED is equal to 10% output. These LEDs 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.	MAX — Δ — Δ — Δ — Δ — Δ — Δ — Δ — Δ — Δ — Δ	MAX — Δ — Δ — Δ — Δ — Δ — Δ — Δ — Δ — Δ — Δ	MAX — Δ — Δ — Δ — Δ — Δ — Δ — Δ — Δ — Δ — Δ	MAX — Δ — Δ — Δ — Δ — Δ — Δ — Δ — Δ — Δ — Δ
POWER	Main Power is “ON” to the ozone generator, when LED is illuminated.	— Δ	— Δ	— Δ	— Δ
HV DRIVE	Power is being sent to the high voltage drive board, when the LED is illuminated.	— Δ	— Δ	— Δ	— Δ
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.	— Δ — Δ — Δ — Δ — Δ	— Δ — Δ — Δ — Δ — Δ	— Δ — Δ — Δ — Δ — Δ	— Δ — Δ — Δ — Δ — Δ
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 also discontinue ozone production.	— Δ	— Δ	— Δ	— Δ
AIR PREP	RK1000mg and RK2500mg Only: The Dryer Timer LED will flash continuously during normal operation and indicates that the dryer timer cycle is operating correctly.	— Δ	— Δ	— Δ	— Δ
DRYER 1	RK1000mg and RK2500mg Only: DRYER 1 LED will be illuminated when dryer chamber 1 is heating.	— Δ	— Δ	— Δ	— Δ
DRYER 2	RK1000mg and RK2500mg Only: DRYER 2 LED will be illuminated when dryer chamber 2 is heating.	— Δ	— Δ	— Δ	— Δ

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 be drawn through the vacuum break, which in turn can cause an ozone leak (see Troubleshooting Guide).

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. Do not close this valve completely. Doing so may cause back pressure on the contact vessel and injection manifold, which will cause a loss of vacuum (see Troubleshooting Guide).

Pneumatic Operating Parameters

Figure 7-2

RK4g w/ O2	Operating Range	Optimum
Air prep system air flow	3 to 4 scfh	4 scfh
Ozone generator air flow	3 to 4 scfh	4 scfh
Vacuum gauge	-3 to -8 in.Hg	-5 in.Hg

RK1000mg	Operating Range	Optimum
Ozone generator air flow	3 to 4 scfh	4 scfh
Vacuum gauge	-3 to -8 in.Hg	-5 in.Hg

RK8g w/ O2	Operating Range	Optimum
Air prep system air flow	6 to 8 scfh	8 scfh
Ozone generator air flow	6 to 8 scfh	8 scfh
Vacuum gauge	-3 to -8 in.Hg	-5 in.Hg

RK2500mg	Operating Range	Optimum
Ozone generator air flow	6 to 8 scfh	8 scfh
Vacuum gauge	-3 to -8 in.Hg	-5 in.Hg

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 RK2 Systems, or service or unit modification not authorized by RK2 Systems.” Please contact your RK2 Systems 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

Air Preparation System

- Power Switch: Check the power switch on the air preparation system (if so equipped). **Note: The air prep system must always have main power when vacuum is being drawn through the ozone system.**
- Indicator Cartridge: Inspect the air preparation system indicator cartridge (if so equipped). A change in the blue crystals to light pink or white in 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 6-2). 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 7-2). Adjust if necessary by following Step 4 of the “Start-Up & Calibration” section.

Ozone Generator

- Indicator Lights: Check the indicator lights on the ozone generator. See Figure 7-1 for Ozone Generator LED Display function.
- Air Flow: Check the SCFH/vacuum gauge assembly attached to the ozone generator. Make sure air flow is within the SCFH range shown on the “Ozone generator air flow” line of the “Pneumatic Operating Parameters” (see Figure 7-2). Adjust if necessary by following Step 5-6 of the “Start-Up & Calibration” section.
- Vacuum: Check the SCFH/vacuum gauge assembly attached to the ozone generator. Make sure pressure is within then range shown on the “Pressure” line of the “Pneumatic Operating Parameters” chart (see Figure 7-2). Adjust if necessary by following Step 5-6 of the “Start-Up & Calibration” section.

Vacuum Break

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

Injection Manifold

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

Ozone Destruct System

- Water Trap: Check water trap for excessive water. It should be no more than half full. If excessive water is observed, see Troubleshooting Guide.
- Ozone Destruct Unit: Check to make sure the power indicator light located on the right side of the unit is illuminated. **Note: Unit must be plugged into an unswitched outlet. Cover of unit will be warm to the touch.**

Monthly Procedures

Air Preparation System

- 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

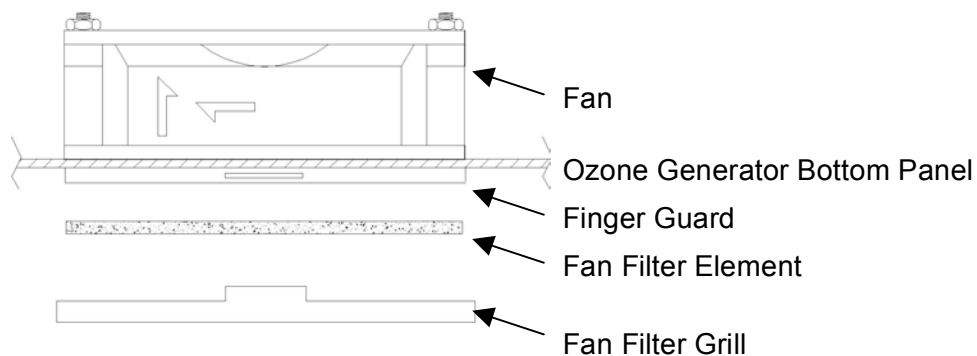
- Cooling Fan Operation: Check to make sure the cooling fan mounted on the bottom panel of the ozone generator is operating. If not, refer to the Troubleshooting Guide.
- Cooling Fan Filters: Check the cooling fan filter element mounted on the fan assembly located at the bottom panel of the ozone generator 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 (if so equipped) as required.

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 and air prep system.
- Step 2:** Turn the Main Power switch on the ozone generator to the “OFF” position. The LED display on 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, PSA Oxygen Concentrator or LPSA Dry Air - Replace the air compressor inlet filter on the 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, PSA Oxygen Concentrator or LPSA Dry Air: Following the procedures outlined in the compressor rebuild kit, rebuild the two compressor heads on each air preparation system module. **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.**
- Air Dryer: RK1000mg and RK2500mg only: Replace sieve material according to the steps outlined below (see Figure 8-2). **CAUTION** Allow the air dryer chambers to cool completely before continuing with the following steps.

Step 1: Straighten out the ends of the dryer chambers.

Step 2: Using a snap ring tool, remove the top snap rings.

Step 3: Remove the top screens.

Step 4: Using a snap ring tool, remove the bottom snap rings.

Step 5: Remove the old sieve material from the dryer chambers and dispose. **Note: When removing the sieve material, be sure not to discard the bottom screens.**

Step 6: Re-install the bottom screens. **Note: The heater rod must be put through the bottom screens.**

Step 7: Fill chamber with new sieve material to 3/4" to 1" below the top of the dryer chamber.

Step 8: Using a snap ring tool, place the bottom snap rings just above the top level of the new sieve material.

Step 9: Re-install the top screens.

Step 10: Using a snap ring tool, place the top snap rings snug against the top screen.

Step 11: Bend the ends of the dryer chambers in-ward for added retention of the sieve material.

Step 12: The RK1000mg and RK2500mg must be turned on for 24 hours prior to system start-up to eliminate any moisture trapped in the new sieve material. See "Start-Up and Calibration, Step 4."

Ozone Generators

- Cooling Filters: Clean or replace the cooling fan filter elements as required.
- Inline Particulate Filter: Replace the inline particulate filter.
- Reaction Chambers: Remove and disassemble the reaction chamber according to the steps outlined below (see Figure 9-3). Check the chamber interior and dielectric tube for oil, dirt or moisture.

Reaction Chamber Removal and Disassembly

Note: Disassembly and service of the reaction chamber(s) is a technical, delicate and critical procedure. Please consult your RK2 Systems 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: Disconnect the high voltage lead from 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, and then follow the assembly and re-installation steps below.

Reaction Chamber 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 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.**
- 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: Correct orientation of end cap.**
- Step 8:** 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 9:** Re-install complete reaction chamber assembly into the ozone generator by following the “Removal and Disassembly” instructions in reverse order, from Step 5 to Step 2. Follow steps outlined in Chapter 7, “Start-Up and Calibration” to re-start the ozone system.

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(s) are closed.

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

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.

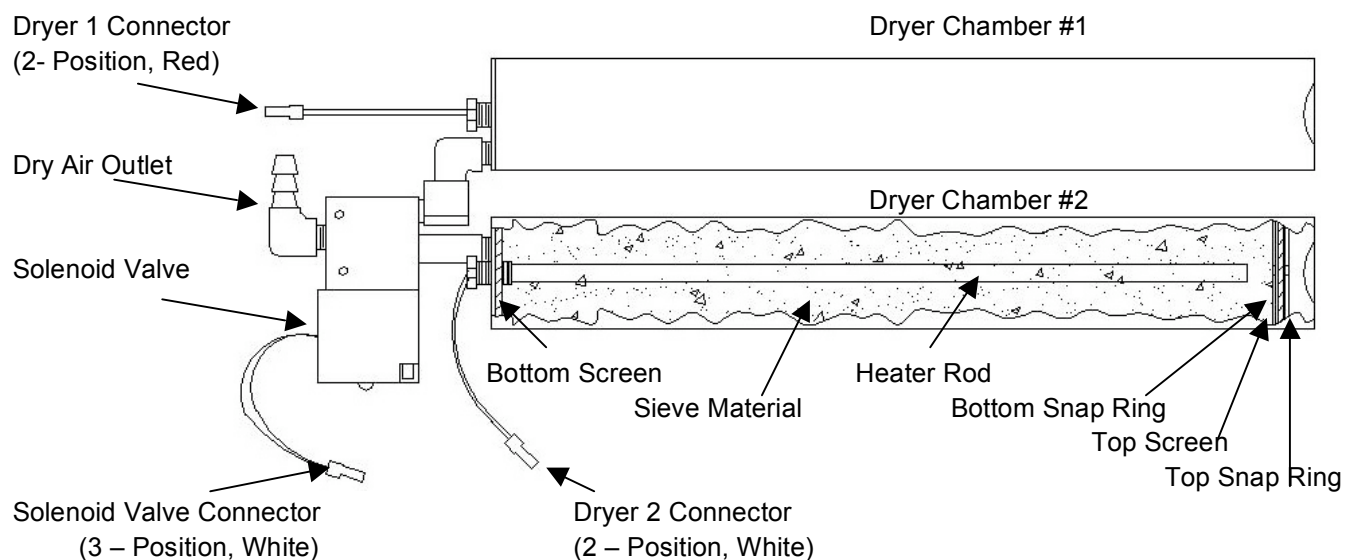
Step 7: Reassemble the contact column and attach vent lines.

Ozone Destruct System

- Off-Gas Vent: Disconnect tubing from top of off-gas vent and remove vent from contact vessel. Disassemble vent and clean inside thoroughly. The float assembly maybe disassembled cleaned, making sure all ports and orifices are clean and free of debris. Clean O-rings or replace as required. Re-assemble and mount vent onto the contact vessel.
- Ozone Destruct Unit: Under normal operating conditions, this unit may require no annual maintenance. However, if a strong odor of ozone can be detected in the air immediately surrounding the unit, the catalyst may require replacement. Follow the directions included with the ozone destruct rebuild kit.

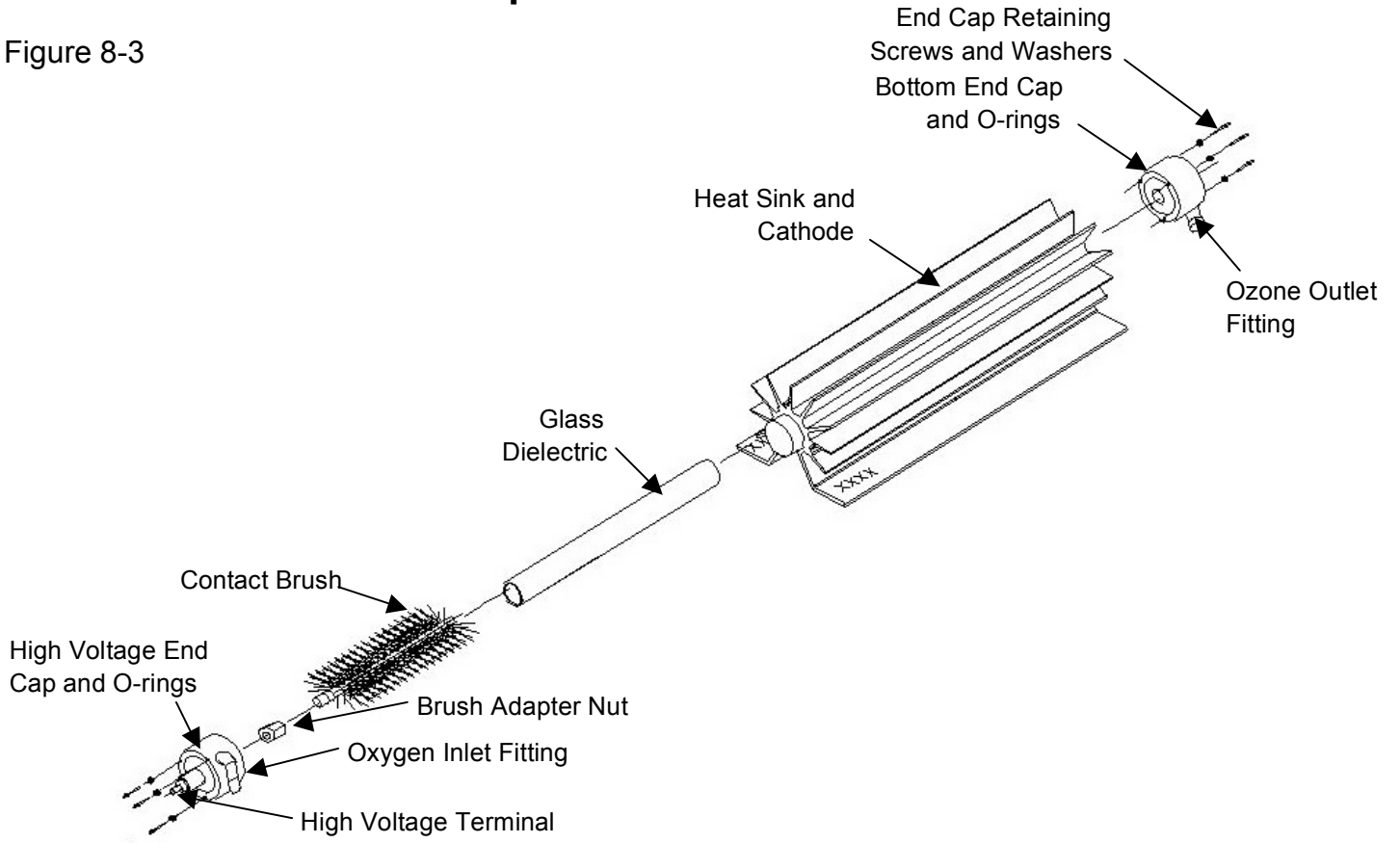
RK1000mg and RK2500mg Heat Regenerative Air Dryer

Figure 8-2



1" Reaction Chamber - Exploded View

Figure 8-3



AIR PREPARATION – PSA Oxygen Concentrator or LPSA Dry Air

PROBLEM/SYMPTOM	POSSIBLE CAUSE	SOLUTION
Unit not operating	-No power to system -Power switch in “OFF” position -Insufficient vacuum through ozone generator (if vacuum switch is equipped with system) -Incorrect wiring	-Check main power to unit -Turn switch to “ON” position -Adjust injector See “Start-Up & Calibration – Step 5” -See “Installation Procedures – Electrical”
Low air flow or no air flow	-Flow meter out of adjustment -Fouled compressor inlet filter -Compressor not functioning	-Adjust flow meter See “Start-Up & Calibration – Step 4” -Replace inlet filter -Rebuild or replace as required
Compressor pressure relief valve making noise	-Excessive backpressure in system -Pinching tubing -Compressor not functioning -Sieve bed (ATF) not functioning	-Inspect check valves for proper operation & replace as required -Replace tubing -Rebuild or replace as required -Replace as required
Indicator cartridge desiccant has changed from blue & white to all pink or white	-Moisture has entered air prep system	-Check & tighten fittings -Rebuild/replace all compressor(s) or sieve bed as required -Replace indicating desiccant
Unit is making excessive noise	-Shipping damage -Fan blocked -Packaging material not removed	-Located damage and repair/replace parts -Clear Obstructions -Remove packaging material

AIR PREPARATION – Heat Regenerative Dry Air (RK1000mg and RK2500mg Only)

PROBLEM/SYMPTOM	POSSIBLE CAUSE	SOLUTION
Air Prep LED not flashing	-Air dryer board not functioning	-Replace air dryer board
Dryer 1 or 2 LED not illuminated	-Air dryer board not functioning -Dryer 1 LED will not illuminate when Dryer 2 LED is illuminated -Dryer 1 is in cool down mode -Dryer 2 LED will not illuminate when Dryer 1 LED is illuminated -Dryer 2 LED is in cool down mode	-Replace air dryer board -See “Theory of Operation and Product Description - Air Preparation System” -See “Ozone Generator LED Display, Figure 7-1”
Dryer chamber(s) not heating	-Heating element not functioning	-Replace Heating element
Indicating desiccant cartridge has changed from blue & white to all pink or white. Moisture has entered air prep system.	-Unit does not have constant power -Excessive air flow -Excessive duty cycle -Excessive relative humidity -Solenoid valve not operating -Air dryer board not functioning	-Unit must have constant power -Adjust flow meter See “Start-Up & Calibration – Step 5” -Duty cycle must not exceed 10 hours in a 24 hour period -Relative humidity must not exceed 75% -Replace solenoid valve -Replace air dryer board

Ozone Generator

PROBLEM/SYMPTOM	POSSIBLE CAUSE	SOLUTION
LED display is not illuminated	<ul style="list-style-type: none"> -No power to unit -Main power switch is in the “OFF” position -Blown fuse(s) -Incorrect wiring -LED display board ribbon cable is disconnected from output control board 	<ul style="list-style-type: none"> -Check circuit breakers -Turn switch to the “ON” positioning -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 -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
‘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
‘External Loop’ LED is illuminated	<ul style="list-style-type: none"> -The external loop does not have continuity 	<ul style="list-style-type: none"> -See “Installation Procedures – Electrical, Step 3” for function
‘Ozone Output’ LED’s are not illuminated	<ul style="list-style-type: none"> -The manual 0-100% output potentiometer is set to 0% output -Remote 4-20mA controller is sending a 4mA signal, which will indicated 0% output 	<ul style="list-style-type: none"> -Adjust potentiometer clock wise to desired set point -No solution required, controller will adjust LED’s automatically
‘Hi Temp’ LED illuminated	<ul style="list-style-type: none"> -Unit is overheating 	<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”
Internal Mother Board ‘Power’ LED not illuminated	<ul style="list-style-type: none"> -No power to mother board -Inoperable mother board -Blown mother board fuse 	<ul style="list-style-type: none"> -See “Installation Procedures – Electrical” -Replacement Mother Board -Replace fuse
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
Fan not operating	<ul style="list-style-type: none"> -Debris caught in fan -Fan inoperable 	<ul style="list-style-type: none"> -Remove debris -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 	<ul style="list-style-type: none"> -See “Start Up & Calibration-Step 4” -Change inline filter -Check all fittings, tighten as required

Ozone Generator - continued

PROBLEM/SYMPPTOM	POSSIBLE CAUSE	SOLUTION
Low air flow or no air flow	-Air prep system not operating properly -Fouled inline filter -Air leak	-See “Start Up & Calibration-Step 4” -Change inline filter -Check all fittings, tighten as required
Low vacuum	-Hydraulics/Pneumatics out of adjustment -Defective check valve(s) -No water in vacuum break -Defective O-ring seals in reaction chamber(s) -Loose internal fittings -Defective dielectrics	-See “Start-Up & Calibration” -Back wash filter (if so equipped), look for obstruction through the ozone loop. -Replace check valves -Fill vacuum break with water – See “Start-Up & Calibration – Vacuum Break” -Check & Replace as required -Check all fittings, tighten as required -Check & 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(s) -No vacuum break -Vacuum break flapper valve stuck Hydraulics out of adjustment	-Assess damage, repair as required, replace check valve(s) -Repair unit as required and install Vacuum break -See “Maintenance Procedures-Annual, Vacuum Break” -See “Start-Up & Calibration”
Ozone small detected from or near ozone generator	-Insufficient vacuum at venturi -Loose internal fittings -Defective O-ring seals in reaction chamber(s) -Defective dielectrics	-Adjust injector See “Start-Up & Calibration” -Check all fittings, tighten as required -Check & replace as required -Check & replace as required

OZONE INJECTION/CONTACTING

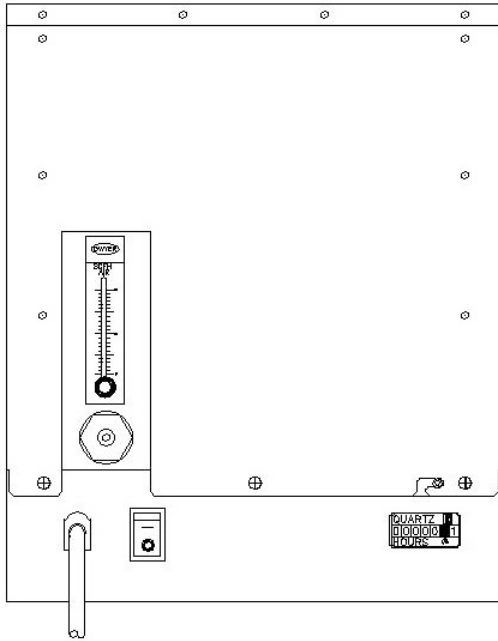
PROBLEM/SYMPPTOM	POSSIBLE CAUSE	SOLUTION
Water backflow past injector check valve(s)	-Defective check valve(s)	-Replace check valve(s)
Water bubbling in vacuum break	-Insufficient vacuum at venturi -Debris on seat of vacuum break flapper valve	-See “Start-Up & Calibration” -See “Maintenance Procedures –Annual, Vacuum Break”
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

OZONE DESTRUCT

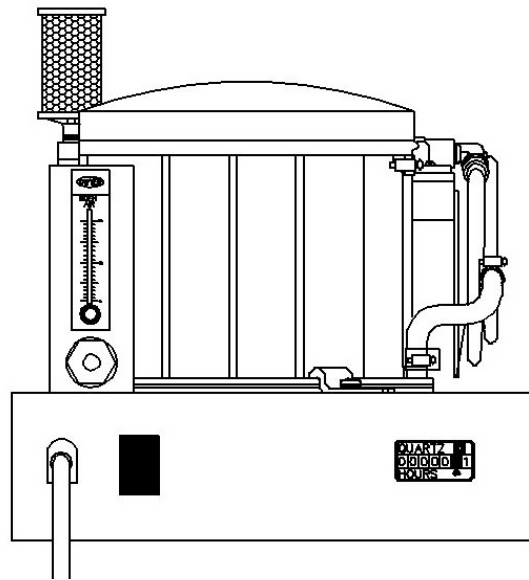
PROBLEM/SYMPPTOM	POSSIBLE CAUSE	SOLUTION
Excessive water in water trap	-Failed off gas vent -Failed spring check valve in water trap Back pressure on drain line	-Clean vent or replace as required -Replace water trap -Remove back pressure
Ozone destruct unit not operating	-No power to unit -Switch not “ON” -Fuse blown -Incorrect wiring connections	-Check main power to unit -Turn switch to “ON” position -Replace fuse -See “Installation Procedures-Electrical”
Ozone destruct unit trips circuit breaker	-Incorrect wiring -Incorrect circuit breaker -Water break flow into unit	-See “Installation Procedures-Electrical” -Replace with correct circuit breaker -Assess damage and rebuild as needed
Ozone destruct indicator lights not on	-Lamp burned out -Switch not “ON” -Blown fuse -Incorrect wiring	-Replace lamp -Turn switch to “ON” position -Replace fuse -See “Installation Procedures-Electrical”
Receive an electrical shock from ozone destruct	-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

APPENDIX A - Specifications

Air Prep System



Shown: RK2 Systems 8 SCFH Oxygen Air Prep System with Cover



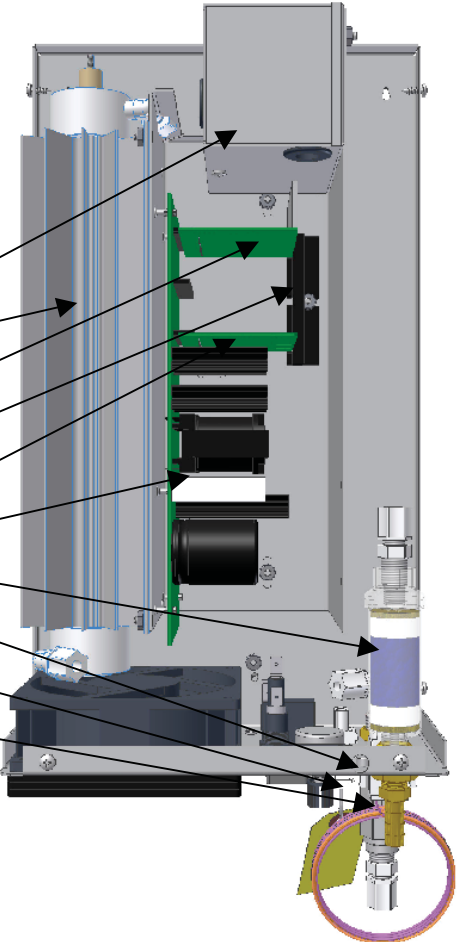
Shown: RK2 Systems 8 SCFH Oxygen Air Prep System with out Cover

AIR PREP SYSTEM	SPECIFICATIONS	OXYGEN OUTPUT/SCFH
6150 - 8 SCFH (Workhorse 8c)	15.5" h x 17" w x 16" d, 45 lbs (with cover)	90% (+/-3%) @ 8 scfh
PDA20 (LPSA20)	15.5" h x 17" w x 16" d, 45 lbs (with cover)	20% @ 20 scfh

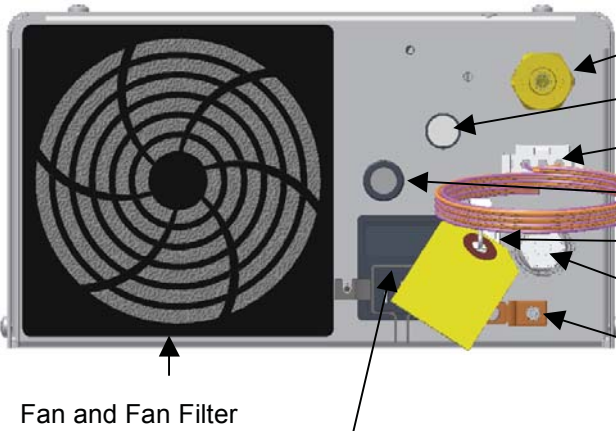
RK4G W/ O2



LED Display Board
(Under Cover)



- High Voltage Transformer
- Reaction Chamber
- High Voltage Drive Board
- Board Retainer Bracket
- Control Board
- Main Mother Board
- Inline Particulate Filter
- Cover Safety Switch
- External Loop
- Remote 4-20mA Control Leads



- Air Prep Inlet
- Manual Ozone Output Adjustment Knob
- Remote 4-20mA Connector
- Fuse Carrier
- External Loop Connector
- Ozone Outlet and Check Valve
- Bonding/Ground Lug

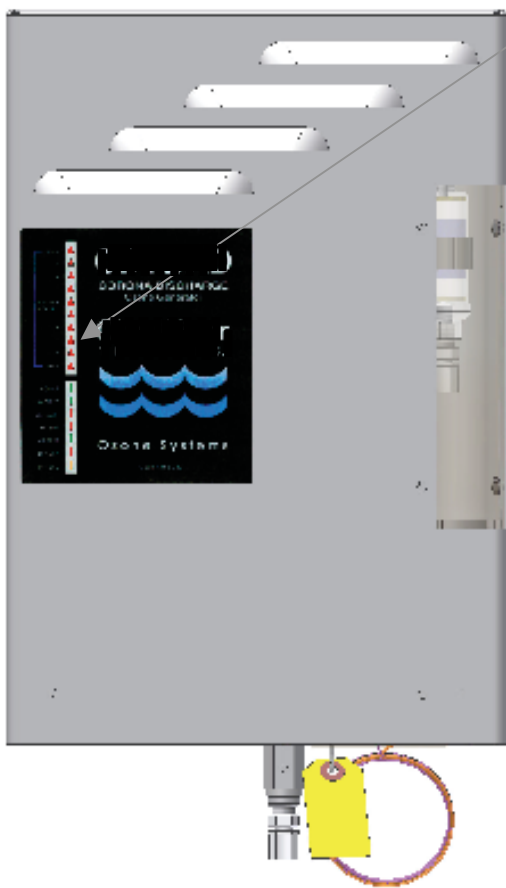
Fan and Fan Filter

Power Entry Module – OFF/ON Switch, Cord Input, Fuse Carrier

Shown: RK4G Ozone Generator w/ O2 (Wire harness omitted for clarity)

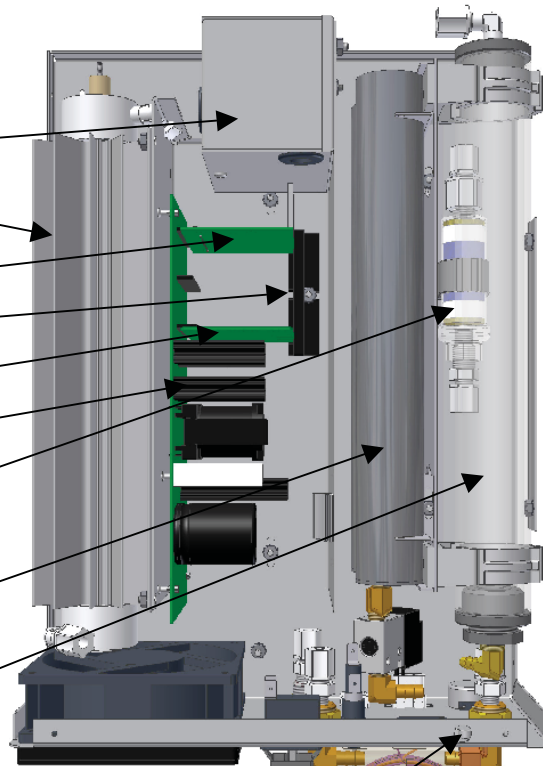
OZONE GENERATOR	SPECIFICATIONS	OZONE OUTPUT/SCFH
F? (; 'K #C&	14" h x 9" w x 5" d, 9.5 lbs	1.3 g/h, 1% @ 4 scfh, Dry Air 4 g/h, 3% @ 4 scfh, Oxygen
Mounting Hole Measurement	14" h x 11" w	

RK1000MG

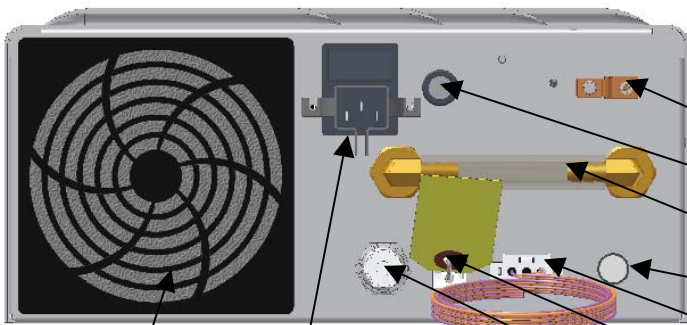


LED Display Board (Under Cover)

- High Voltage Transformer
- Reaction Chamber
- High Voltage Drive Board
- Board Retainer Bracket
- Control Board
- Main Mother Board
- Inline Particulate Filter (Under indicating cartridge)
- Air Dryer (#1 Front, #2 back) and solenoid valve
- Indicating Desiccant Cartridge



- Cover Safety Switch
- External Loop
- Remote 4-20mA Control Leads



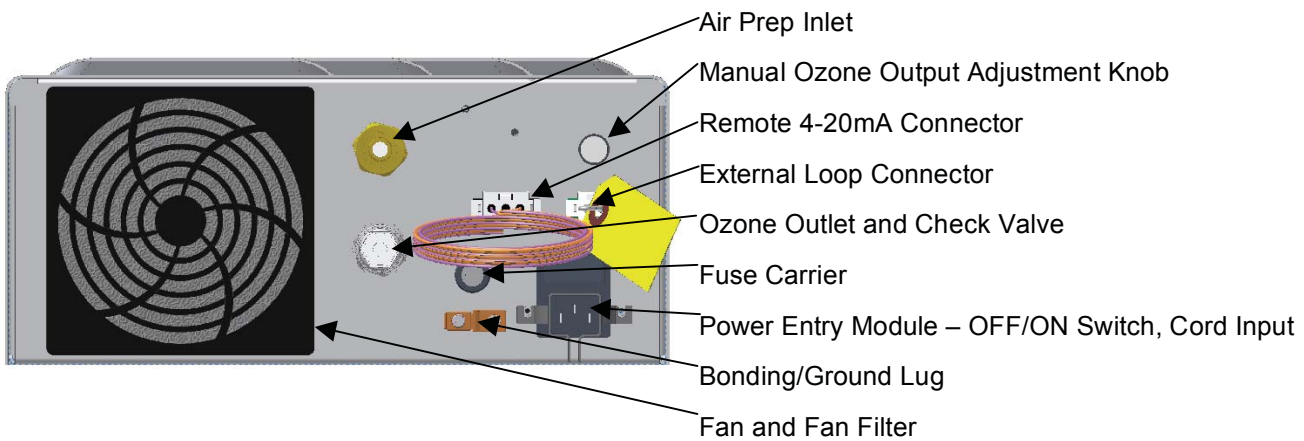
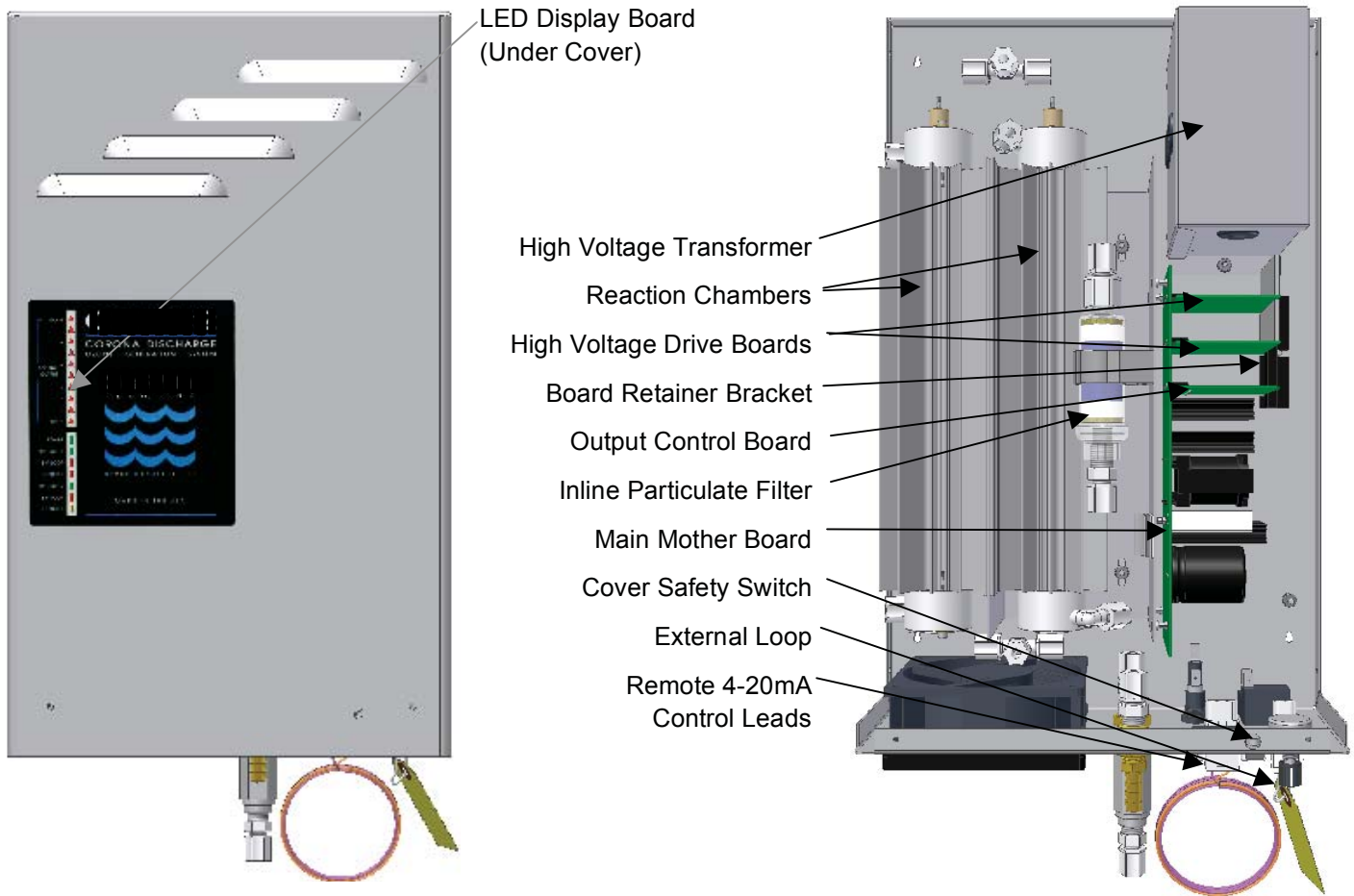
- Fan and Fan Filter
- Power Entry Module – OFF/ON Switch, Cord Input

- Bonding/Ground Lug
- Fuse Carrier
- External Air Prep Loop
- Manual Ozone Output Adjustment Knob
- Remote 4-20mA Connector
- External Loop Connector
- Ozone Outlet and Check Valve

Shown: RK1000MG Ozone Generator (Wire harness omitted for clarity)

OZONE GENERATOR	SPECIFICATIONS	OZONE OUTPUT/SCFH
RK1000MG	19" h x 11.5" w x 5" d, 14.5 lbs	1.3 g/h, 1% @ 4 scfh
Mounting Hole Measurement	13" h x 13.5" w	

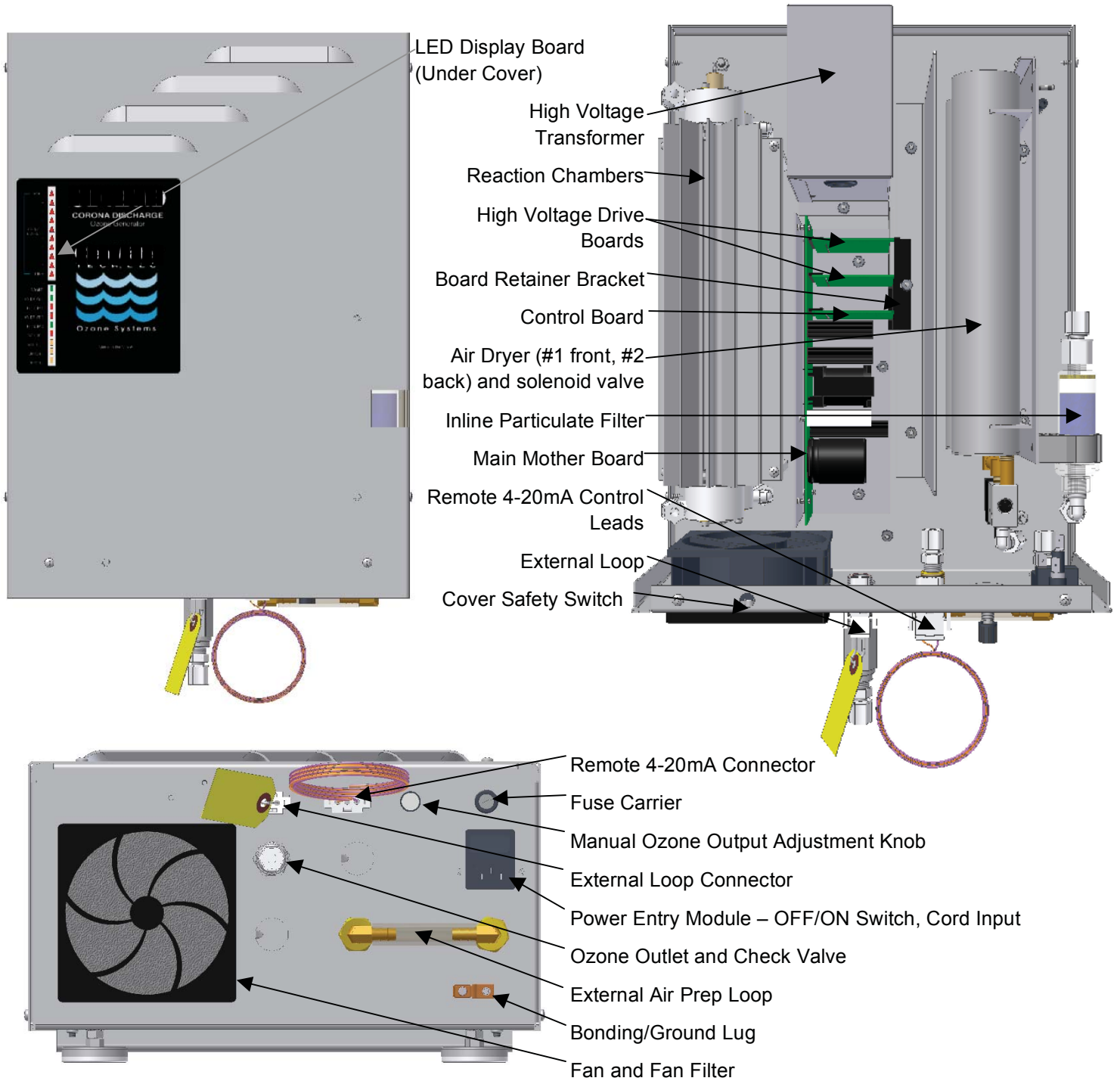
RK8G W/ O2



Shown: RK8G W/ O2 Ozone Generator (Wire harness omitted for clarity)

OZONE GENERATOR	SPECIFICATIONS	OZONE OUTPUT/SCFH
RK8G	21.5" h x 11.5" w x 5" d, 14.5 lbs	3 g/h, 1% @ 4 scfh, Dry Air 8 g/h, 3% @ 4 scfh, Oxygen
Mounting Bracket Measurement	15.5" h x 13.5" w	

RK2500MG



Shown: RK2500MG Ozone Generator (Wire harness omitted for clarity)

OZONE GENERATOR	SPECIFICATIONS	OZONE OUTPUT/SCFH
RK2500MG	22”h x 13.5”w x 8.25”d, 20 lbs	2.6 g/h, 1% @ 8 scfh
Mounting Bracket Measurement	Z-Bar Mount	

APPENDIX B – Parts List

Description	Part Number
Air Preparation 6150 8 SCFH and LPSA20	
Compressor Inlet Filter	OXS350
Compressor Rebuild Kit – OS80	OXS355
Compressor Rebuild Kit – LPSA20	AC89
Pressure Relief Valve	OXS360
Compressor Vibration Mount	OXS365
Indicating Desiccant Refill (if so equipped)	DES16
Air Preparation RK4G and RK8G	
Complete Air Dryer Assembly	ADP100
Air Dryer Heating Rod	ADP20
Solenoid Valve, 3-way, 24VDC	SV220
Indicating Desiccant Refill	DES16
Dryer Sieve Desiccant Refill	DES12
Dryer Media Screen, Small	SCN20
Dryer Media Screen, Large	SCN30
Dryer Media Retaining Ring	HDW137
Dryer Chamber Retaining Spring	SPG110
Ozone Generator	
Reaction Chamber – Complete	RCC17
Dielectric Anode 1”	RCC76
Non-High Voltage End Cap	RCC57
High Voltage End Cap	RCC53
O-ring Set	ORS50
Mother Board	CCA1325
Control Board	CCA1232
LED Display Board – RK2500mg	CCA1350
High Voltage Drive Board – RK4G, RK1000mg, RK8G, RK2500mg	ELPC5040
High Voltage Drive Board – RK8G, RK2500mg	ELPC5042
LED Display Board – RK4G	ELPC5054
LED Display Board – RK1000mg	ELPC5050

Description	Part Number
Ozone Generator	
LED Display Board – RK8G	ELPC5052
Complete Board Set – RK4G	ELPC5064
Complete Board Set – RK1000mg	ELPC5060
Complete Board Set – RK8G, RK2500mg	ELPC5062
High Voltage Transformer – RK4G, RK1000mg	ELTR100
High Voltage Transformer – RK8G, RK2500mg	ELTR105
Check Valve – 1/4fpt X 1/4mpt	CKV22
Cooling Fan	FA47
Cooling Fan Filter	FA40
Inline Particulate Filter	FLT34
Fuse, Bussmann MDL-5 5 amp, 250VAC Slow Blow, Main Power	FUS20
Fuse, Littlefuse 239003 – 3 amp, 250VAC Slow Blow, Mother Board	FUS15

APPENDIX C – Maintenance Kits

Air Preparation System

ASP80 and ASP86 - Maintenance Kit – 6150 8 SCFH and LPSA20 air preparation system

ASP80 Part #	ASP86 Part #	QTY	Description
OXS350	OXS350	1	Oxygen Concentrator – Replacement Compressor Inlet Filter
OXS356	AC89	1	Oxygen Concentrator – Compressor Rebuild Kit
OXS360	OXS360	1	Oxygen Concentrator – Compressor Pressure Relief Valve
OXS370	OXS370	1	Oxygen Concentrator – Replacement Cover Filter

Ozone Generators

ASP111B - Maintenance Kit – RK4G W/ O2 ozone generator

Part #	QTY	Description
FA40	1	Filter – Cooling Fan filter
FLT34	1	Filter – Inline Particulate Filter
ORS50	1	O-Ring Set
CKV22	1	Check Valve – 1/4fpt X 1/4mpt
FUS20	5	Fuse, Bussmann MDL-5 – 5 amp, 250VAC Slow Blow, Main Power
FUS15	1	Fuse, 3A, 250VAC Slow Blow, 5X20mm

ASP110B - Maintenance Kit – RK1000mg and RK2500mg ozone generator

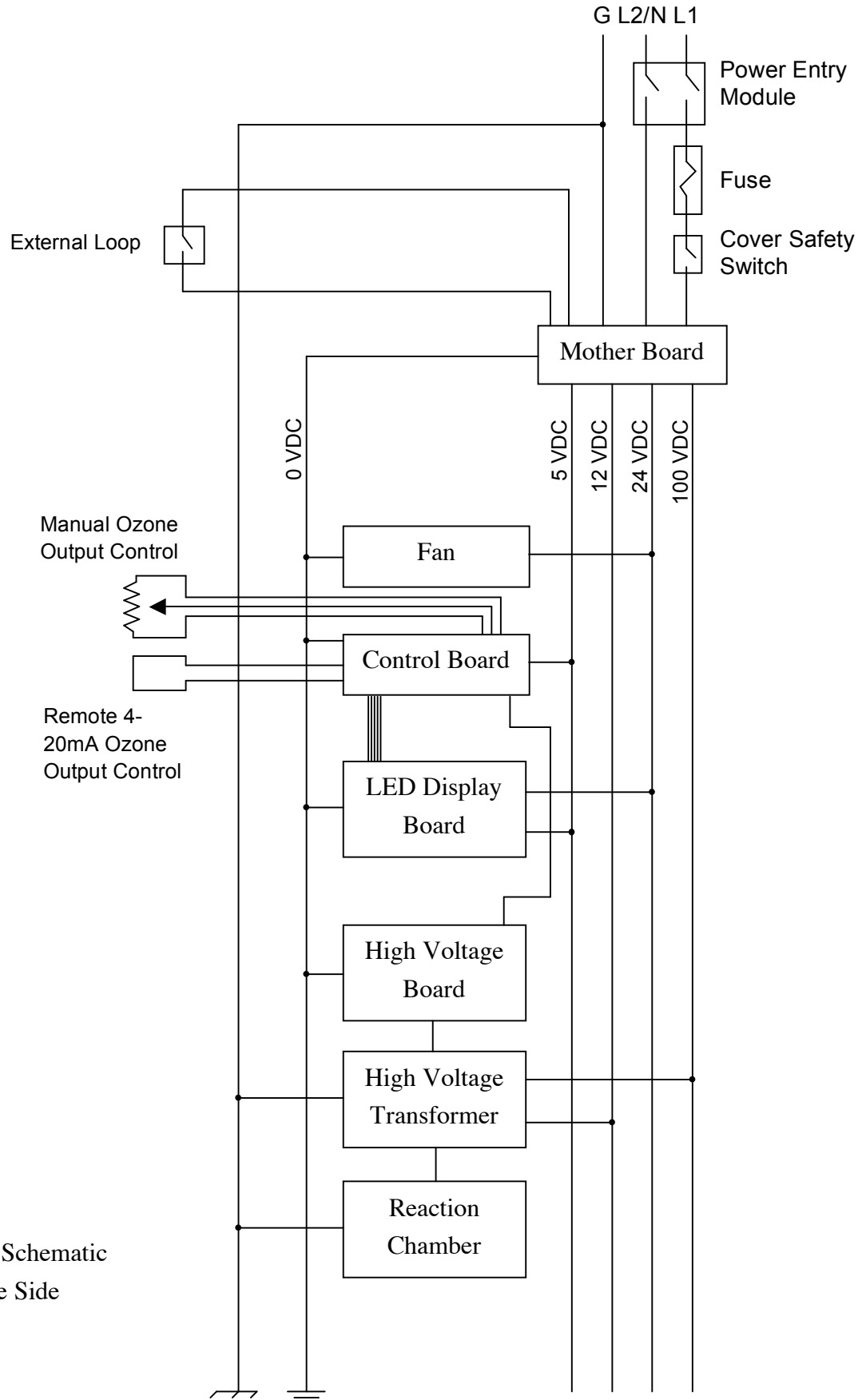
Part #	QTY	Description
FA40	1	Filter – Cooling Fan Filter
FLT34	1	Filter – Inline Particulate Filter
ORS50	1	O-Ring Set
CKV22	1	Check Valve – 1/4fpt X 1/4mpt
DES16	1	Indicating Desiccant Refill
DES12	1	Dryer Sieve Desiccant Refill
FUS20	5	Fuse, Bussmann MDL-5 – 5 amp, 250VAC Slow Blow, Main Power
FUS15	1	Fuse, 3A, 250VAC Slow Blow, 5X20mm

ASP112 – Maintenance Kit – RK8G W/ O2 ozone generator

Part #	QTY	Description
FA40	1	Filter – Cooling Fan filter
FLT34	1	Filter – Inline Particulate Filter
ORS50	2	O-Ring Set
CKV22	1	Check Valve – 1/4fpt X 1/4mpt
FUS20	5	Fuse, Bussmann MDL-5 – 5 amp, 250VAC Slow Blow, Main Power
FUS15	1	Fuse, 3A, 250VAC Slow Blow, 5X20mm

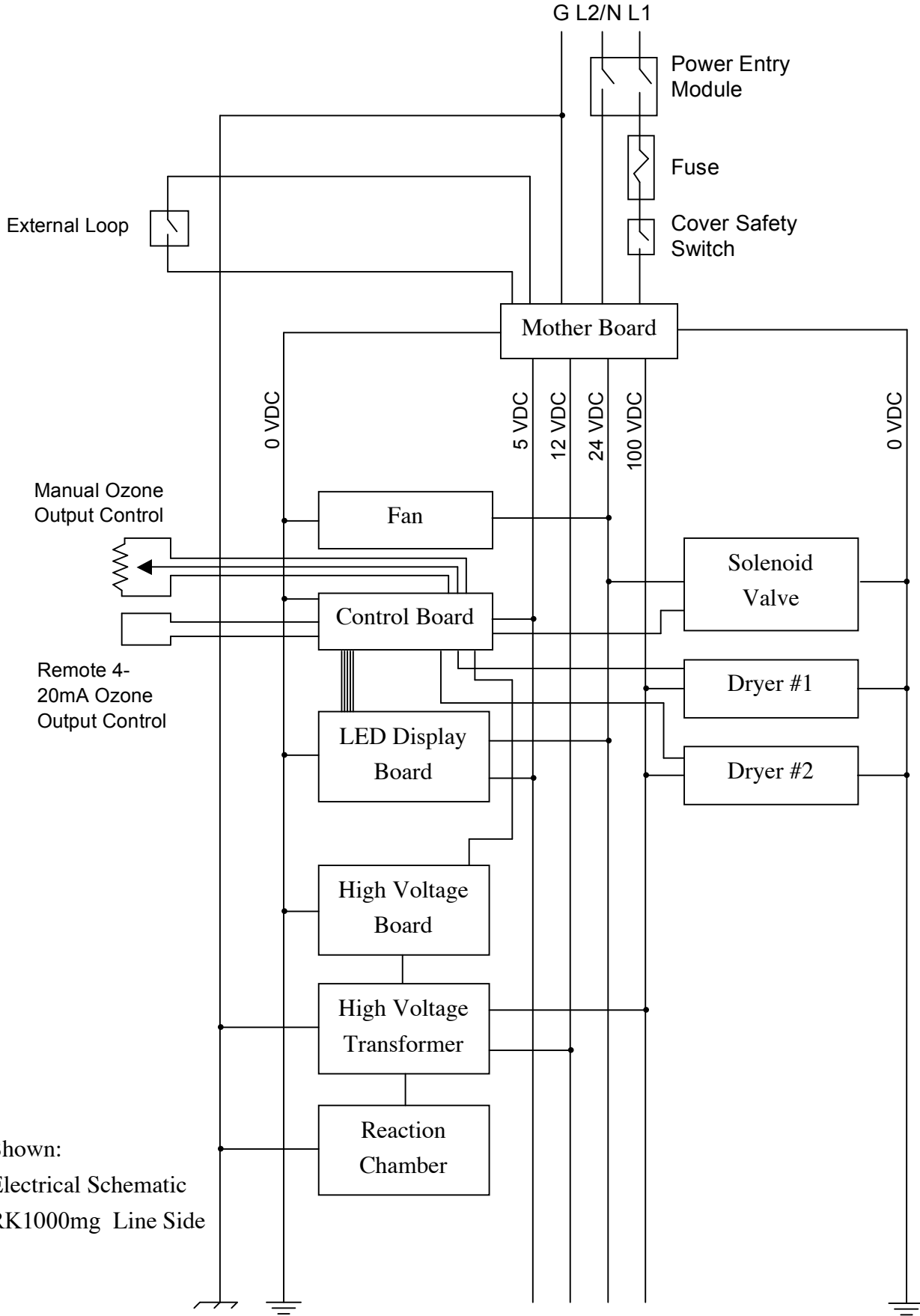
APPENDIX D – Logic Schematics

RK4G W/ O2



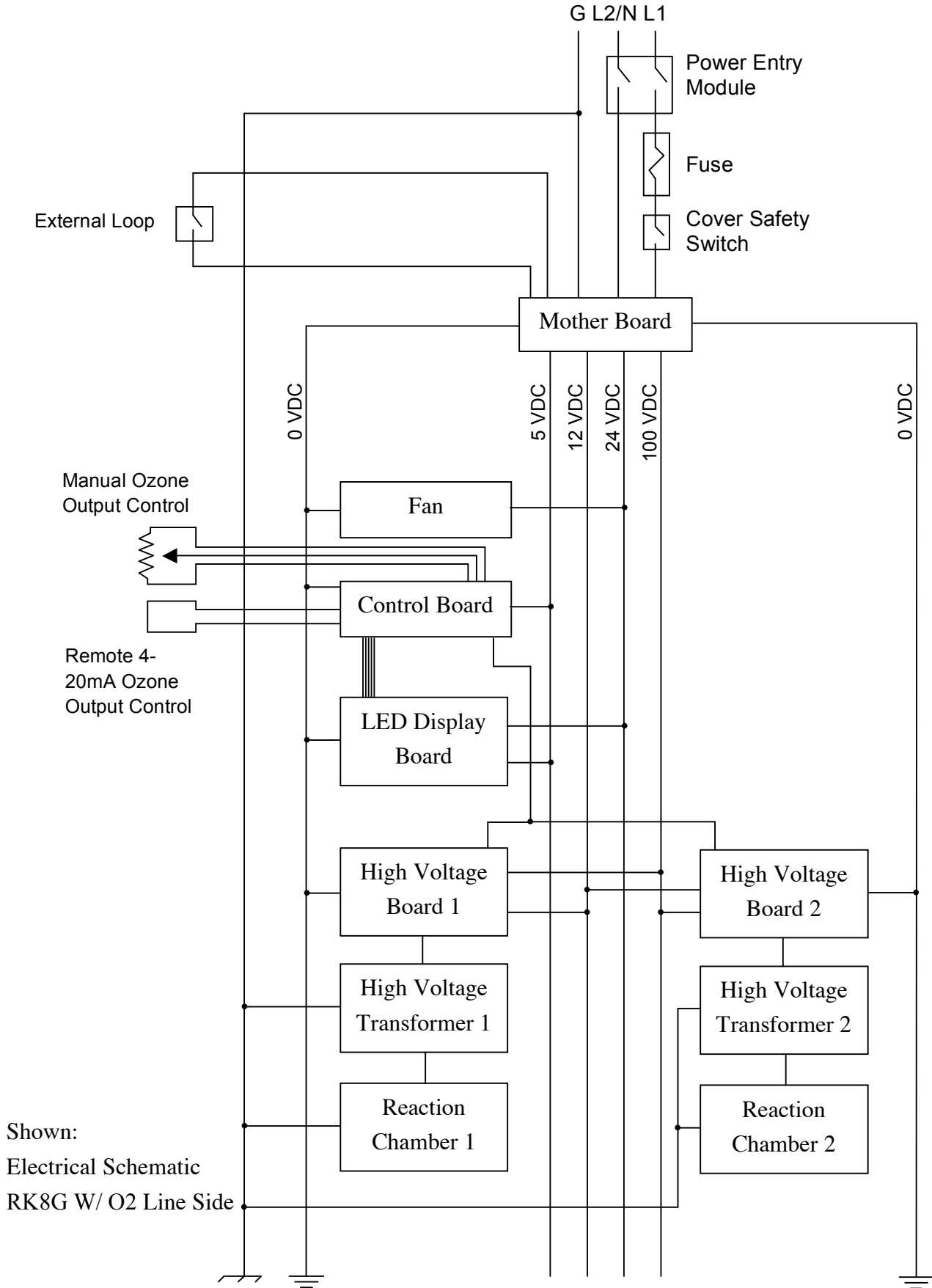
Shown: Electrical Schematic
RK4G W/ O2 Line Side

RK1000mg



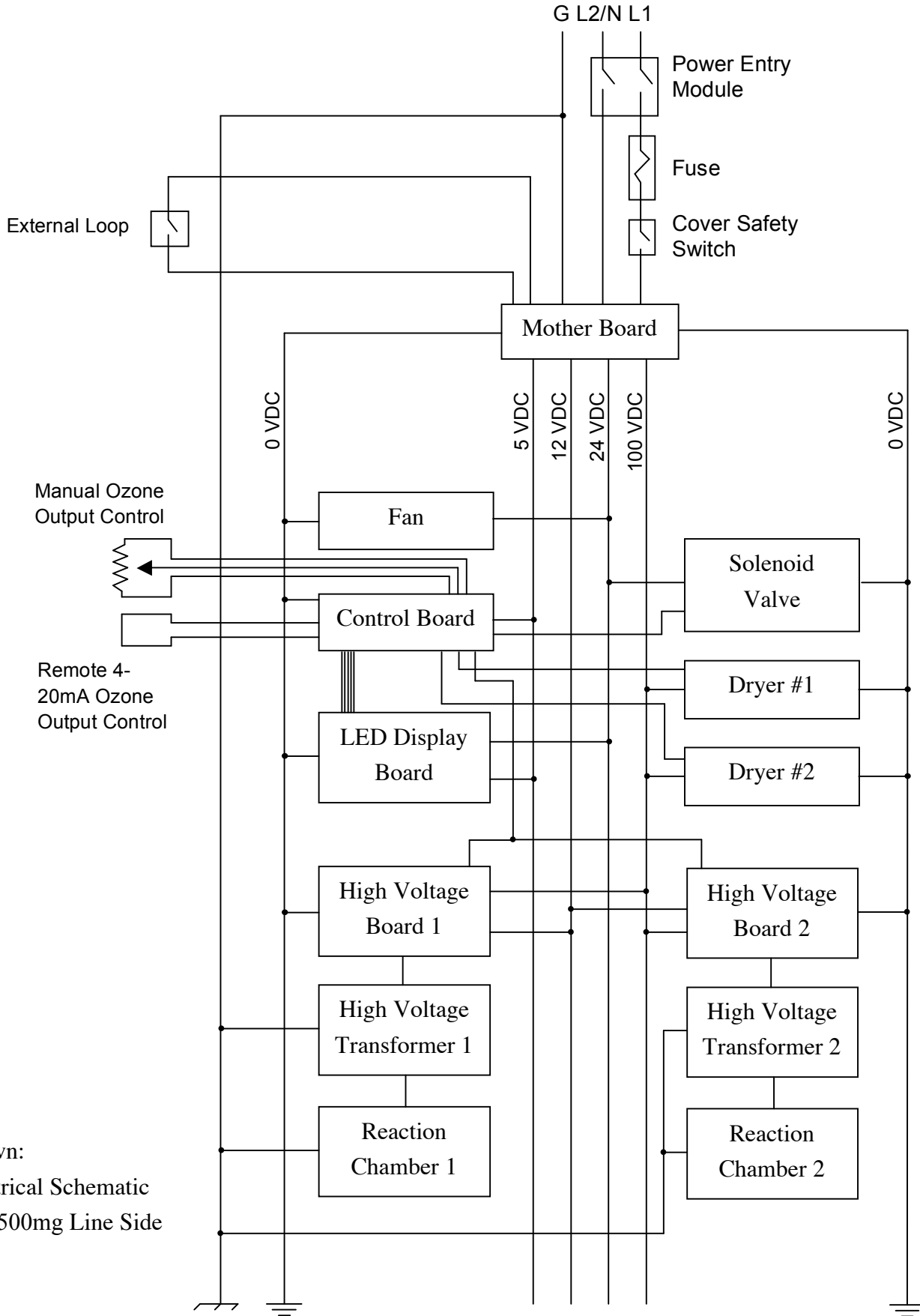
Shown:
Electrical Schematic
RK1000mg Line Side

RK8G W/ O2



Shown:
Electrical Schematic
RK8G W/ O2 Line Side

RK2500mg



Shown:
Electrical Schematic
RK2500mg Line Side

RK2 Systems, Inc. Limited One-Year Warranty

Summary of the Warranty

RK2 Systems, Inc. ("RK2") 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 RK2, 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 RK2; 2) The warranty period shall begin on the date of the bill of sale to the end user if the installation date is more than 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 RK2 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 of 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 RK2
- service or unit modification not authorized by RK2

Obtaining Service Under the Warranty

Any product and/or part not performing satisfactorily may be returned to RK2 for evaluation. A Return Goods Authorization (RGA) number must first be obtained by either calling or writing your local authorized dealer, distributor or RK2 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 RK2 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 RK2, it proves to be defective while under warranty, RK2 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 RK2 manufactured products without prior permission shall void any and all warranties. For service, contact your authorized dealer or distributor or RK2 direct at (760) 746-7400.

Exclusive Warranty

There is not other expressed warranty on RK2 products and/or parts. Neither this warranty, or 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 limitations 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.