Ozone Systems

Installation & Operation Manual

AviOzonx

Aircraft Water Disinfection

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Integrated Ozone Systems
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INTRODUCTION

This Installation and Operation Manual is written to assist in the installation, operation and maintenance of ozone delivery systems manufactured by ClearWater Tech, LLC. This equipment has been designed using the most modern materials and technology available.

Please read this manual carefully and in its entirety before proceeding with any installation, operation or maintenance procedure associated with this equipment. Failure to follow these instructions could result in personal injury, damage to the equipment or reduced product performance.

In an ongoing effort to improve reliability and operating efficiency, ClearWater Tech may find it necessary to make changes to its products. Therefore, the information contained in this manual may not conform in every respect to earlier versions of ClearWater Tech ozone system found in the field. If you have any questions, please contact your ClearWater Tech dealer or the ClearWater Tech service department.

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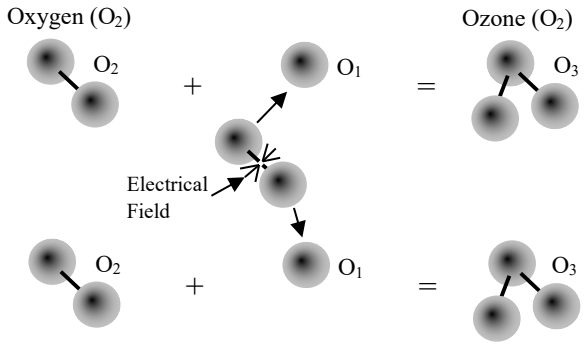
OVERVIEW

How Ozone Is Generated

Ozone is generated by exposing oxygen molecules (O_2) in an air stream to a controlled, high-energy electrical field. As the air stream passes through the electrical field produced inside the ozone generator, some oxygen molecules are split, forming single oxygen atoms (O_1). These oxygen atoms then recombine with other oxygen molecules in the air stream, forming ozone (O_3)



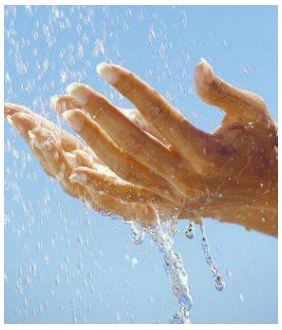
Properties of Ozone

Ozone is the most powerful oxidizer available that can be safely used in water treatment[1]. It is used to treat drinking water, bottled water, swimming pool water, wastewater, food and beverage processing water, and in many other applications. Ozone in gaseous form is used to treat organic contamination in the air and treat surfaces. Ozone is effective in performing the following:

- **Disinfection** – Bacterial disinfection, inactivation of viruses and cysts.
- **Oxidation of Inorganics** – Precipitates, iron, manganese, sulfides nitrides and organically-bound heavy metals
- **Oxidation of Organics** – Including organics causing color, taste, and odor problems. Some detergents and pesticides, phenols, VOCs, turbidity control and micro-floccuity control and micro-flocculation of soluble organics.

Molecular Weight	48
Odor	Readily detectable at concentrations above 0.02 ppm in air
Color	Bluish in ozone generator cell, but ozone/air mixture exiting generator is invisible – even at high ozone concentrations.
Gas Density:	2.144 grams/liter at 32°F (Approximately 150% that of oxygen).
Solubility	Only partially soluble in water, but about 10-20 times more soluble than oxygen (at 68°F).

Benefits of Ozone Use



- Ozone is generated on site – no transportation or storage is required
- The most powerful oxidizer commercially available – very effective for disinfection and oxidation without handling problems.
- Ozone creates no potentially harmful by-products (such as THMs) – the only by-product is oxygen.
- Ozone leaves no telltale taste or odor.

[1] Water Quality Association, "Ozone for POU, POE and Small Water System Water Treatment Applications," Lisle, IL, 1999

Safety Information

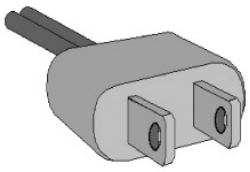
Safety Warnings

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 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: CLEARWATER TECH OZONE GENERATORS OPERATE AT HIGH VOLTAGE. MAKE SURE UNIT IS UNPLUGGED BEFORE REMOVING ANY OF THE PANELS ON THE AVIOZONX SYSTEM. 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. 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.

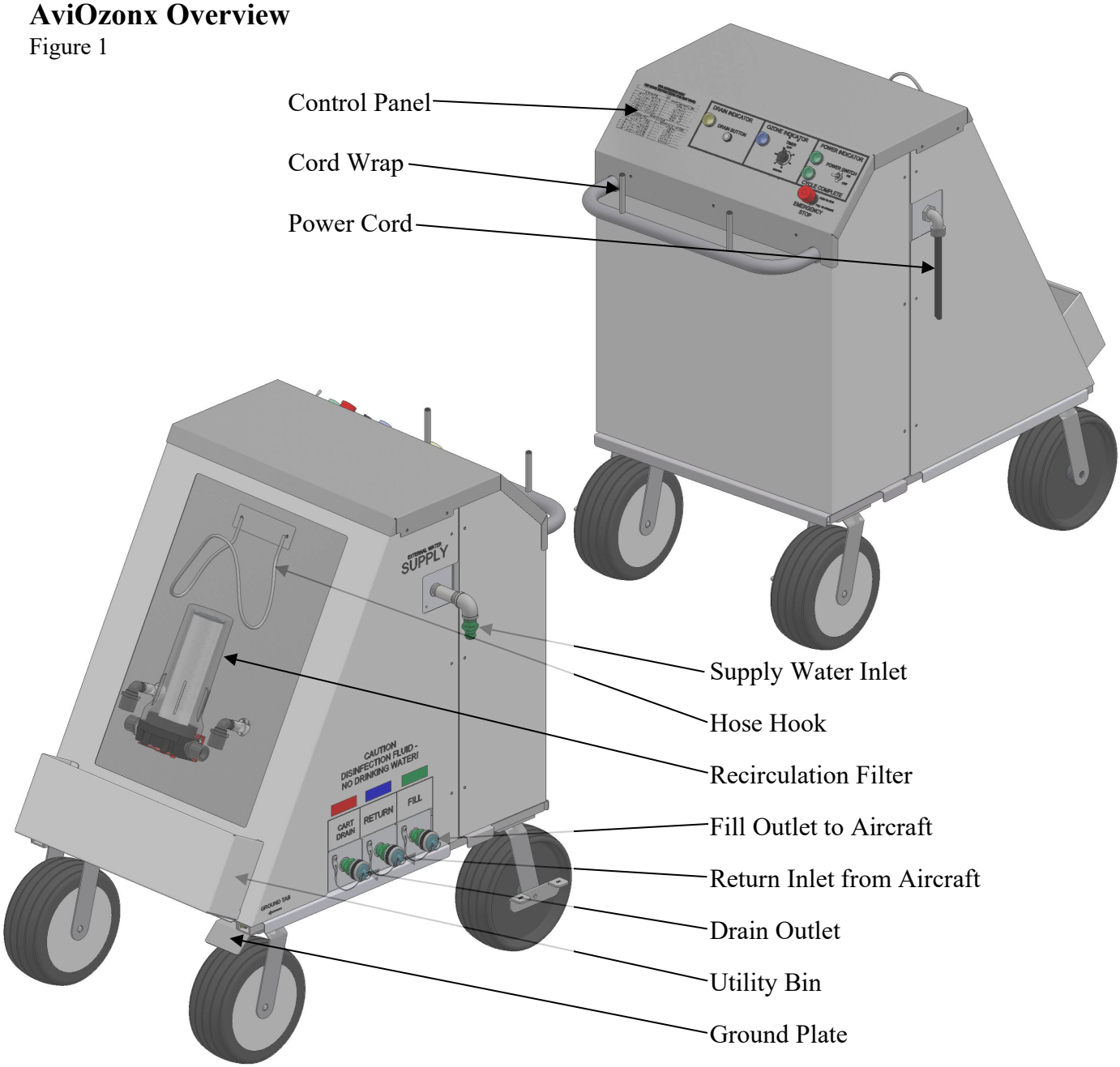
3. Do not use extension cords with the AviOzonx system.
4. If the power cord becomes damaged, replace the power cord before operating the AviOzonx system.
5. For best performance, use an outlet connected to the power grid. If a generator is required, use a generator with integrated GFCI, and remove the GFCI from the AviOzonx system's power cord.
6. Ensure the AviOzonx system has a connection to a water source with the appropriate flow and pressure capacity before turning the system on. 5 GPM, 30PSI minimum.
7. Ensure the AviOzonx system has the fill hoses properly connecting the fill outlet of the AviOzonx system to the aircraft being treated before turning the system on.
8. Ensure the AviOzonx system has the return hoses properly connecting the return inlet of the AviOzonx system to the aircraft being treated before turning the system on.
9. Ensure the AviOzonx system has the drain hose properly connected to the drain connection on the AviOzonx system and run to a suitable facility drain before turning the system on.
10. Do not supply the AviOzonx system with heated water. Damage to the system may occur.
11. Properly close off all valves on the supply and aircraft hoses and depressurize the AviOzonx system before disconnecting any of the hose connections. Disconnecting a pressurized line can cause water to spray into the AviOzonx system and cause damage.
12. Follow your airlines standard operating procedure for direction on disinfection times for various aircraft, and proper testing procedure to verify disinfection on the aircraft.
13. Use extreme caution if the AviOzonx system needs to be energized with any of the external skins removed. Only do so to perform the maintenance or troubleshooting task required and return external skins as soon as possible for safe operation.

Product Description

The AviOzonx system is an advanced ozone delivery system designed and engineered specifically for the aerospace industry. The AviOzonx system takes ordinary supply water and infuses dissolved ozone into the water going onto the aircraft. Once the tank on the aircraft fills up, water begins to return to the AviOzonx system, where additional dissolved ozone is added. As water is recirculated to the aircraft and back to the AviOzonx system, the dissolved ozone level is built up in the water tank on the aircraft. Your airline should provide you with a standard operating procedure to give guidance for how long to recirculate water, how to properly test and verify ozone levels in the water in the potable water system, and how to properly use that ozonated water to disinfect the water lines on the aircraft. Once the disinfection procedure is complete, the dissolved ozone in the water tank will quickly breakdown to oxygen, there is only a need to drain the water from the aircraft to bring the water level in the tanks down the appropriate levels for flight after a successful disinfection procedure.

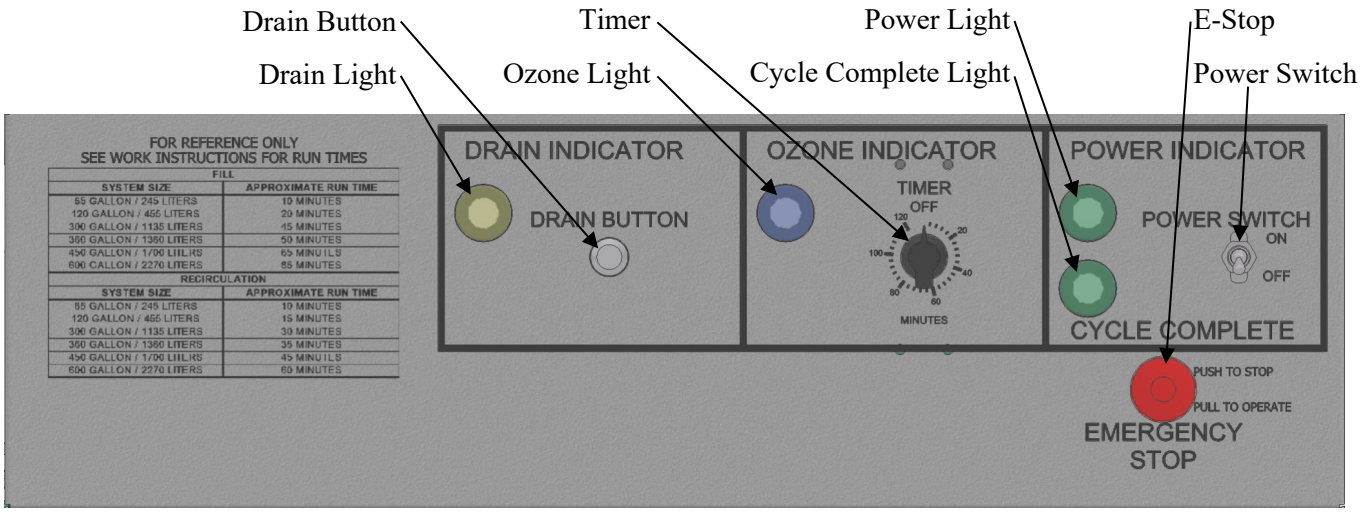
AviOzonx Overview

Figure 1



AviOzonx Control Panel

Figure 2



Control Panel

The front panel allows the operator to control and monitor the AviOzonx system while in use.

Power Switch – This turns the system on and off. If the AviOzonx system has not been depressurized when the power switch is turned "OFF", the AviOzonx system will attempt to depressurize the water in the internal hydraulics and in the connected hoses by routing the water to the drain outlet before turning off.

E-Stop – This is the emergency stop and will cut power to an internal relay which will cut main power to the entire system. Push the E-Stop in to cut power to the entire system, pull the E-Stop out to restore power to the entire system.

Power Light – This light is illuminated when the AviOzonx system is "ON". This light will not be illuminated when the system is "OFF".

Cycle Complete Light – This light is illuminated after the Timer has completed a cleaning cycle. The "Cycle Complete" light will remain illuminated until a new cleaning cycle is initiated by turning the timer, or until the AviOzonx system is turned off. In the event of the operator starting a cleaning cycle and leaving to work on other things, this light will allow the operator to know the cleaning cycle was complete when they return.

Timer – Twisting the timer clockwise will initiate a cleaning cycle. Refer to your airline's standard operating procedure to know what time to set the timer to for the aircraft being treated. Once the timer reaches 0 minutes the AviOzonx system will automatically shut down and the "Cycle Complete" light will illuminate.

Ozone Light – This light will be illuminated when ozone is being produced.

Drain Button – Pushing the drain button will tell the AviOzonx system to try to drain as much water from the aircraft using the AviOzonx system's integrated pump. If the AviOzonx is currently in a cleaning cycle (the timer is not at 0 minutes) when the button is pushed, the drain light will begin to blink to let the operator know the AviOzonx system will automatically drain the aircraft once the cleaning cycle is done. If the AviOzonx system is not currently in a cleaning cycle (the timer is at 0 minutes) when the button is pushed, the drain light will turn on and the AviOzonx system will open the drain valve and attempt to pull water from the aircraft and push the water out of the drain line. Once the pressure on the outlet of the pump drops below 5psi for longer than 3 seconds the AviOzonx system will shut down, even if there is still water on the plane, this is to protect the pump.

Drain Light – This lamp will be illuminated when the AviOzonx system is attempting to drain the aircraft. This lamp will blink if the operator has pushed the drain button during a cleaning cycle to indicate the AviOzonx system will automatically attempt to drain the aircraft once the cleaning cycle has completed.

Power Cord Wrap

On the handlebar, two vertical posts have been provided that allow the power cord to be wrapped around for convenient storage.

Power Cord

For operator safety, the AviOzonx system is designed with a Ground Fault Circuit Interrupt (GFCI) in the power cord. When the GFCI is working, the indicator light on the GFCI will be illuminated and there will be power to the system. If the indicator is not illuminated, press the "Reset" button. Do not use an extension cord. If the power cord becomes damaged, replace the power cord before operating the AviOzonx system. For best performance, use an outlet connected to the power grid. If a generator is required, use a generator with integrated GFCI, and remove the GFCI on the AviOzonx system's power cord.

Supply Water Inlet

Connect this inlet to a water source with an appropriate flow and pressure capacity, 5GPM at 30 PSI minimum (Figure 3). Make this connection and turn on water flow to the AviOzonx system before turning the system on.

Hose Hook

This hook is provided as a convenient location to store water hoses used with the AviOzonx system.

Recirculation Filter

A pleated filter is provided to filter water coming back to the AviOzonx system from the overflow of the aircraft water tank. Ozone is a natural flocculant and can cause material in the water to come out of solution, or material on surfaces in the tank to flake off. This filter is designed to catch any large particulate that might flow out of the tank on the aircraft. This filter will need to be monitored and replaced when it can no longer adequately filter the water. The filter bowl is positioned upside down to allow the AviOzonx system to be more easily drained of water if it is going to be exposed to freezing temperatures.

Fill Outlet to Aircraft

Connect this outlet of the AviOzonx system to the appropriate port of the aircraft. Consult your airline's standard operating procedures for guidance on which port on the aircraft to connect to (Figure 3). See Appendix C for a list of available hose kits and adapters available to make this connection. The AviOzonx system is designed to push water from the "Fill Outlet" into the bottom of the tank on the aircraft, typically the drain port, but consult the standard operating procedures and follow the instructions provided in those procedures. Ensure the AviOzonx system has the fill hoses properly connecting the "Fill Outlet" to the aircraft being treated before turning the system on.

Return Inlet from Aircraft

Connect this inlet of the AviOzonx system to the appropriate port of the aircraft (Figure 3). Consult your airline's standard operating procedures for guidance on which port on the aircraft to connect to. See Appendix C for a list of available hose kits and adapters available to make this connection. Once the tank on the aircraft is full of water, the water flows back to this return inlet on the AviOzonx system, typically through the overflow port, but consult the standard operating procedures and follow the instructions provided in those procedures. Ensure the AviOzonx system has the return hoses properly connecting the return "Return Inlet" to the aircraft being treated before turning the system on.

Drain Outlet

If the AviOzonx system is attempting to drain the water from the aircraft, or just depressurizing the lines, it will send excess water out of this drain outlet. Ensure the AviOzonx system has the drain hose properly connected to the drain connection on the AviOzonx system and run to a suitable facility drain before turning on the AviOzonx system (Figure 3). See Appendix C for a list of available hose kits and adapters available to make this connection.

Utility Bin

This utility bit is provided as a convenient location to store tools and adapters used with the AviOzonx system

Ground Plate

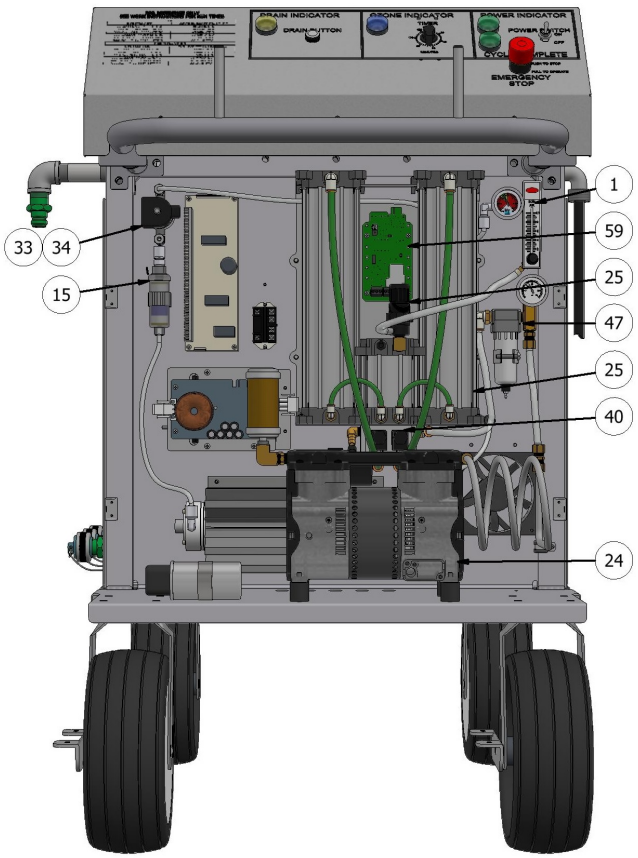
Before connecting the AviOzonx system to the aircraft it is good practice to properly ground the AviOzonx system by making a ground connection to this ground plate. Consult the airlines standard operating procedure for more information on this grounding procedure.

Theory of Operation

In this section we describe the inner workings of the AviOzonx system. The AviOzonx system can be broken up into six sections: Oxygen Concentrator, Ozone Generator, Hydraulic System, Ozone Injector, Off-Gas Destruct and Control Circuitry.

Oxygen Concentrator

ClearWater Tech 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 -60°F dew point with very low pneumatic pressures, minimizing noise and reducing compressor wear.



The air preparation system directly affects how many grams of ozone are produced per hour, which in turn also affects the 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 the greater percent of ozone can be produced. Using a PSA oxygen concentrator allows the AviOzonx system to produce ozone at a high grams per hour while also maintaining a high percent by weight. The high percent by weight results in a high solubility of the ozone gas in solution resulting in a high dissolved ozone level.

Our Air Compressor (#24) sends compressed ambient air through an aluminum cooling coil to cool down the compressed gas, and a coalescing filter (#47) to remove any water droplets. A pressure gauge (#47) measures the pressure at this point. Under normal operation the pressure should swing between approximately 15 psi and 28 psi.

From here the cooled and water-separated compressed gas is fed into the switching solenoid valve (#40) which is powered from the oxygen control board (#59). This solenoid valve will direct flow to one of the two sieve beds (#25), building pressure in the bed and allowing the sieve material to absorb nearly all the moisture and nitrogen from the compressed gas stream. Before the sieve material become saturated and unable to absorb more moisture and nitrogen, the solenoid valve switches and begins to pressurize the second sieve bed, while the first is depressurized and purged to remove the moisture and nitrogen. Each sieve bed feeds 90% +/-3% pure oxygen into a mixing chamber which combines the flow, regulates the outlet pressure, and acts as a buffer tank to even out the output through switching events. The pressure regulator (#25) will limit the outlet pressure to 10 psi.

The regulated concentrated oxygen goes through a flow gauge with vacuum/pressure gauge (#1). Flow and pressure will change as the aircraft water tank begins to fill and as the system transitions to recirculation mode. The flow shouldn't exceed 10 CFH, and the pressure shouldn't exceed 5 psi. **WARNING: DRAWING FLOWS HIGHER THAN 12 CFH FROM THE OXYGEN CONCENTRATOR CAN DAMAGE SIEVE MATERIAL IN THE**

OXYGEN CONCENTRATOR. Typically, while the tank on the aircraft is filling, the vacuum/pressure gauge will read -10 inHg. This vacuum will begin to reduce as the tank on the aircraft fills with water.

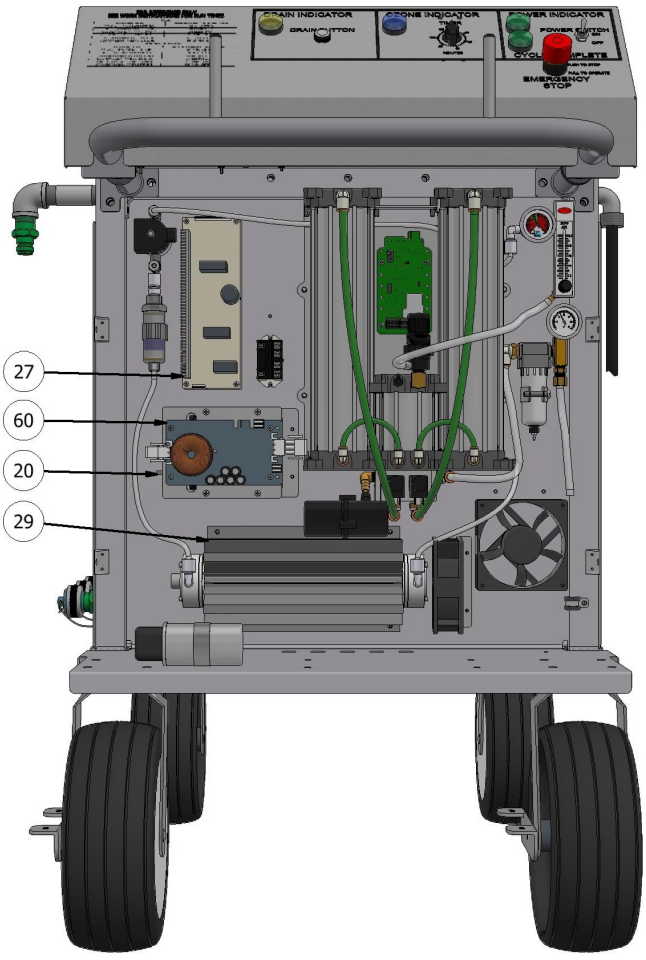
The pressurized oxygen then flows through a solenoid valve (#33 and #34). This valve is opened when the oxygen system is powered. If air is allowed to be pulled through the system without the oxygen system powered, pressurized and switching, the sieve material can be damaged.

The pressurized oxygen then flows through a moisture indicating air filter (#15). Under normal operation the beads in this filter should be dark blue. The beads will turn a light pink as they absorb moisture (Figure 4). If the beads in this indicating air filter are turning pink there is a problem with the oxygen system, the system needs to be serviced.

Finally, the pressurized oxygen flows into the ozone cell.

Ozone Generator

The AviOzonx system is equipped with a 2-inch ozone reaction chamber (#29). The oxygen feed gas enters the fused, thermally protected reaction chamber; 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 (O_3). ClearWater Tech ozone generators are designed to supply high concentrations of ozone gas. The vacuum created at the ozone injector draws the ozone gas created by the ozone generator into the water line.



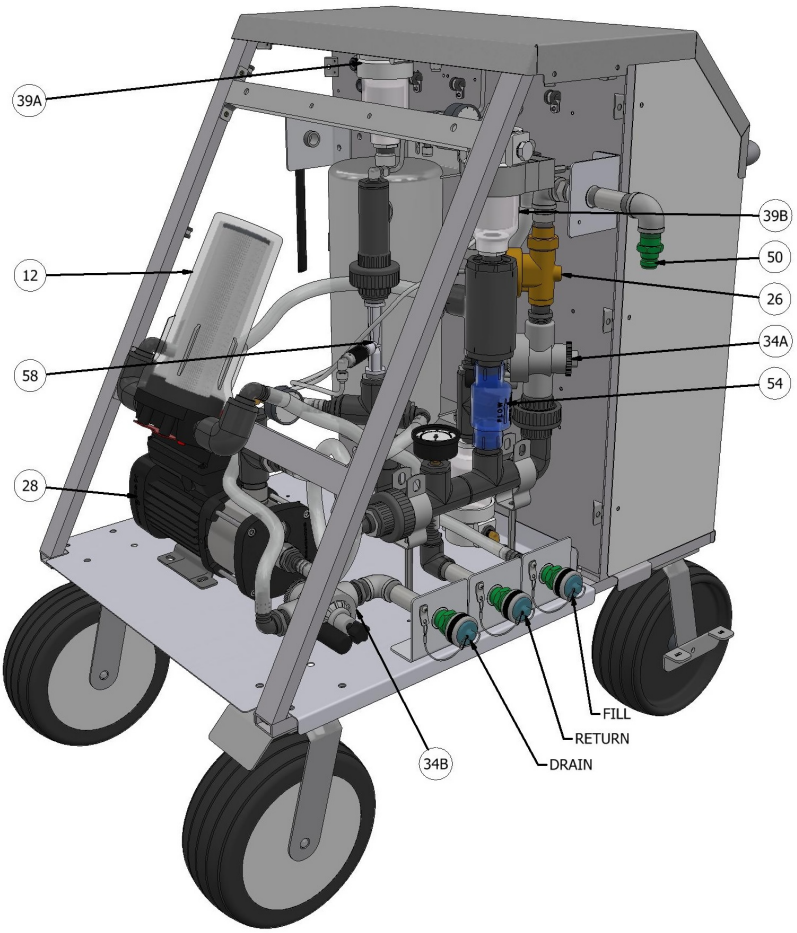
To power the ozone generator, two universal power supplies (#27) generate +/-24V DC which is supplied to our HO Drive board (#60). The HO Drive board in turn powers our high voltage transformer (#20). The output of the high voltage is approximately 7000 Vrms. WARNING: THE OZONE SYSTEM PRODUCES HIGH VOLTAGE, USE EXTREME CAUSION IF THE AVIOZONX SYSTEM NEEDS TO BE ENERGIZED WITH ANY OF THE EXTERNAL SKINS REMOVED. ONLY DO SO TO PREFORM THE MAINTENANCE OR TROUBLESHOOTING REQUIRED AND RETURN THE EXTERNAL SKINS AS SOON AS POSSIBLE FOR SAFE OPERATION.

The generated ozone flows through the back panel to the ozone injection system.

Hydraulic System

Water flows into the AviOzonx system through the supply water inlet (#50). The water pressure is regulated down to ~20 psi with the inlet pressure regulator (#26) and a solenoid valve (#34A) controls when water is added to the hydraulic system. A pressure gauge shows the water pressure at the inlet to the water pump. While the tank on the aircraft is filling and the inlet solenoid valve is open, this pressure gauge should read between 20-30 psi. Once the tank becomes full and water is coming back to the AviOzonx system from the aircraft (recirculation mode), this pressure gauge could read as little as 0 psi.

The water flows into the booster pump (#28). On the outlet of the booster pump there is another pressure gauge and a pressure switch (#35A). Under normal operation this pressure will start at around 30-40 psi with an empty tank on the aircraft and slowly build as the tank on the aircraft fills up. Once the AviOzonx system goes into recirculation mode, this gauge on the outlet of the water pump will read 80-90 psi. The pressure switch at this location is set to ~5psi and will prohibit the water pump from turning on unless this minimum pressure is satisfied.

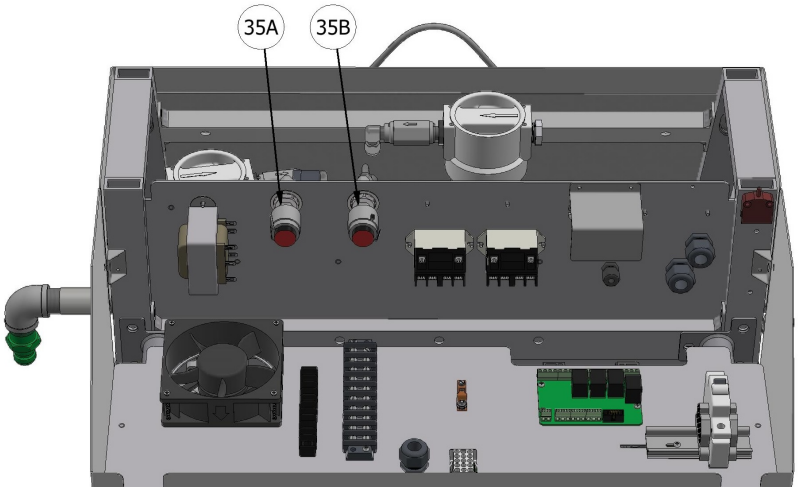


NOTE: If the pressure on the outlet of the water pump is not greater than 5psi, the water pump will not be energized, this is to ensure the pump does not run dry.

The pressurized water flowing from the water pump goes into the ozone injector (#58). This injector uses the Bernoulli principal to force the water from high pressure to low pressure which naturally creates a vacuum at the transition point. This vacuum draws in the ozone feed gas generated in the ozone chamber and breaks up the ozone gas into micro-bubbles in the water.

The outlet of the injector has a pressure gauge and pressure switch (#35B) connected to it. Under normal operation this pressure will start at 0 psi with an empty tank on the aircraft and slowly build as the tank on the aircraft fills up. Once this pressure rises to 40-50psi, the pressure switch will close, and the control board will turn off the inlet solenoid valve (#34A). If the pressure at this point drops, and the pressure switch opens, the inlet solenoid valve will open again and add more water to the hydraulic system until this pressure once again causes the pressure switch to close.

The ozonated water flows into a contact tank which allows any undissolved gas to float up and be removed from the system through an off-gas vent (#39A), the de-gassed ozonated water flows out of the bottom of the contact tank and leaves the AviOzonx system through the “FILL” outlet port.



Once the tank on the aircraft becomes completely full and water begins flowing back to the AviOzonx system, the water will enter the AviOzonx system through the “RETURN” inlet port. The water is filtered through the pleated filter (#12) and then any

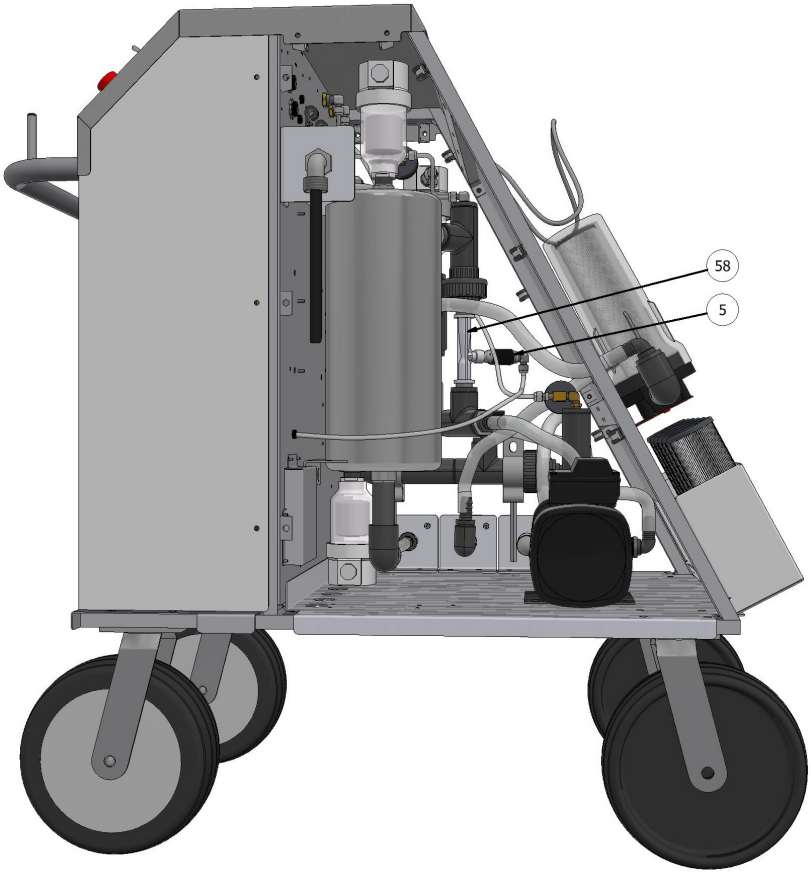
gas in the returning water is separated from the flow through a second off-gas vent (#39B). Recirculated water flow back to the AviOzonx system is typically 5 GPM minimum.

The de-gassed recirculating water goes through a flapper check valve (#54) and returns to the inlet of the water pump to repeat the ozone injection process.

When in drain mode, the drain solenoid valve (#34B) is opened and water from the outlet of the pump is allowed to exit the AviOzonx system through the drain outlet port.

Ozone Injection

The ozone injector serves two purposes: first, it creates the vacuum required to safely draw the ozone gas from the ozone generator and second, 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.



The ClearWater Tech AviOzonx system uses only Mazzei® injectors for maximum mass transfer efficiency. The injector (#58) 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 to increase the ratio of bubble surface area to the amount of ozone entering the water.

The ozone line feeding the injector has a check valve (#5) to make sure water isn't allowed to get to the ozone chamber, and a vacuum relief (#53) which will draw in ambient air if the vacuum created the injector exceeds 10 inHg. With the hydraulic system so dynamic, the vacuum can swing significantly, this vacuum relief is present to protect the ozone cell and drive circuitry.

A Short Course in Fine Bubbles

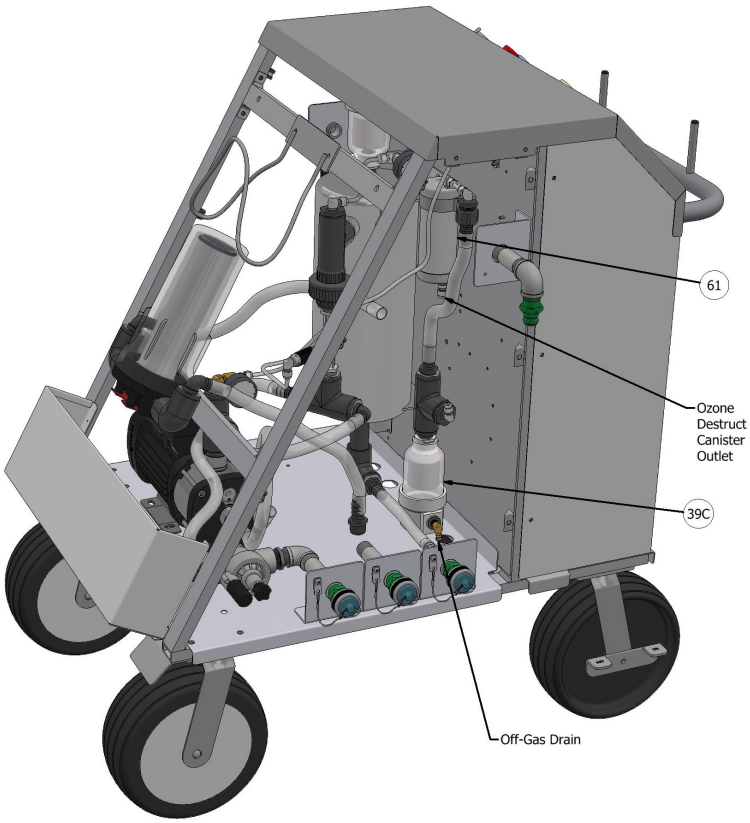
Lesson 1 – The large bubble (20mm) has a volume of 4.19 cm^3 and a surface area of 12.6 cm2.

Lesson 2 – 296 small bubbles (3mm) could be made from the large bubble in lesson 1. They would have a total surface area of 83.6cm^2. 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!

Off-Gas Destruct

It is important to properly destroy any undissolved ozone to make sure the ozone does not create an unhealthy environment around the AviOzonx system.



The gas that is removed from the hydraulic system through off-gas vents #39A and #39B will send their gas to a water separator which employs off-gas vent (#39C) which is upside down and serves to purge water from the system when the water level in the water separator gets too high. The outlet of this off-gas vent runs through a hole in the bottom of the AviOzonx system. It is normal to observe water dripping from this vent when the AviOzonx system is running.

The water-separated off-gas then travels up to a chemical ozone destruct canister (#61). This canister uses a catalyst to significantly increase the transition of ozone back to oxygen, this catalyst is not consumed in this reaction. The catalyst will become deactivated if it is exposed to liquid water. If water is observed coming out of this ozone destruct canister, the canister must be replaced immediately.

WARNING: OPPERATING THE AVIOZONX SYSTEM WITH A DAMAGED OZONE DESTRUCT CANISTER OR MALFUNCTIONING OFF-GASS DESTRUCT SYSTEM CAN ALLOW OZONE GAS TO BE RELEASED INTO THE ENVIRONMENT AROUND THE AVIOZONX SYSTEM. OZONE GAS IS A POWERFUL OXIDIZER AND CAN BE DANGEROUS TO HUMANS IN HIGH CONCENTRATIONS.

Control Circuitry

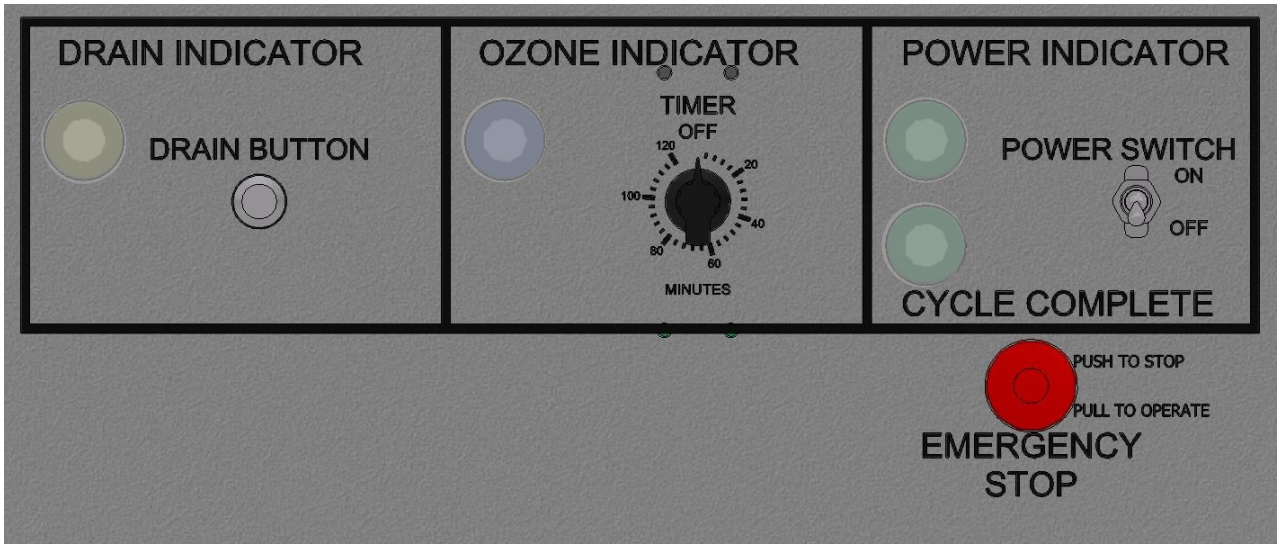
Front Control Panel

The AviOzonx system incorporates a sophisticated microcontroller to take in the user input, monitor the ozone generator output, monitor the water pump pressure, monitor the contact tank pressure, control the inlet water supply through the inlet solenoid valve and control the drain solenoid valve. A timer sets the disinfection cycle time.

Here is a description of the lights on the front control panel.

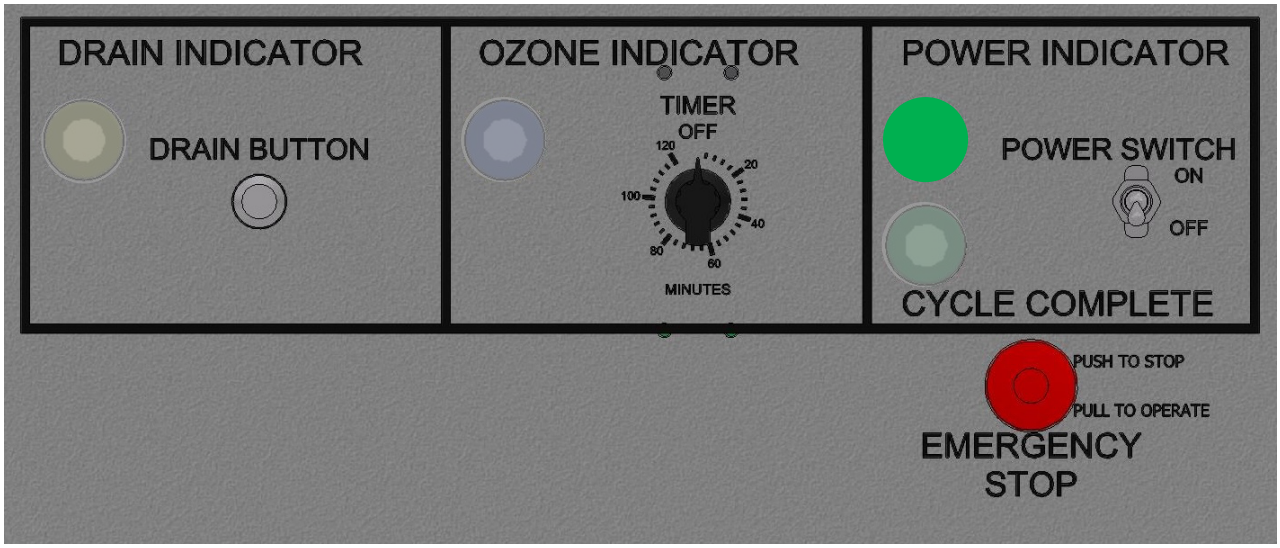
System Off

- All Lights off



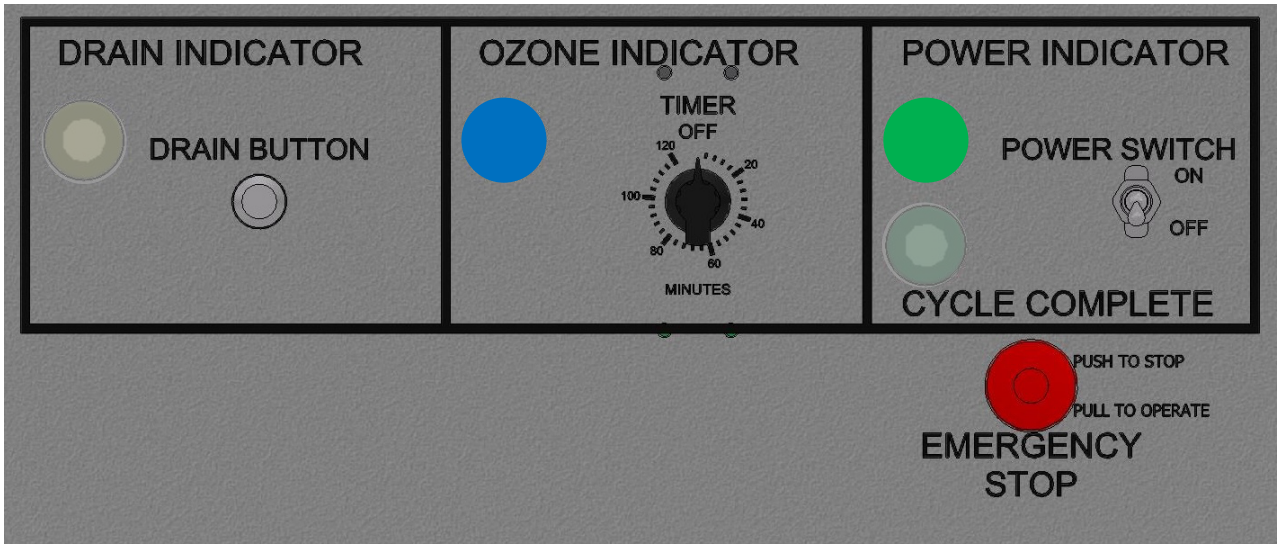
System On

- Power switch “ON”
- Power indicator on solid green
- In this mode the AviOzonx system is in standby mode ready for either the timer knob to be activated, or the drain button to be pushed.



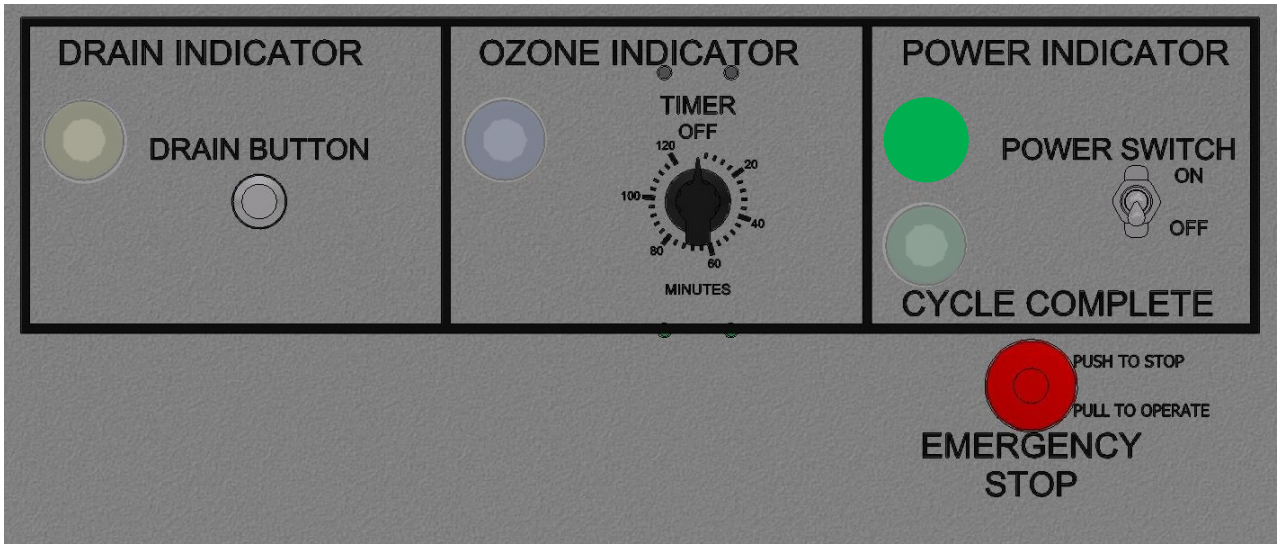
System Running Making Ozone

- Power Switch “ON”
- Timer knob active
- Power indicator solid green
- Ozone indicator solid blue
- In this mode the AviOzonx system is actively disinfecting. The water pump is on, the ozone system is on. The AviOzonx system will continue in this mode until the timer completes.



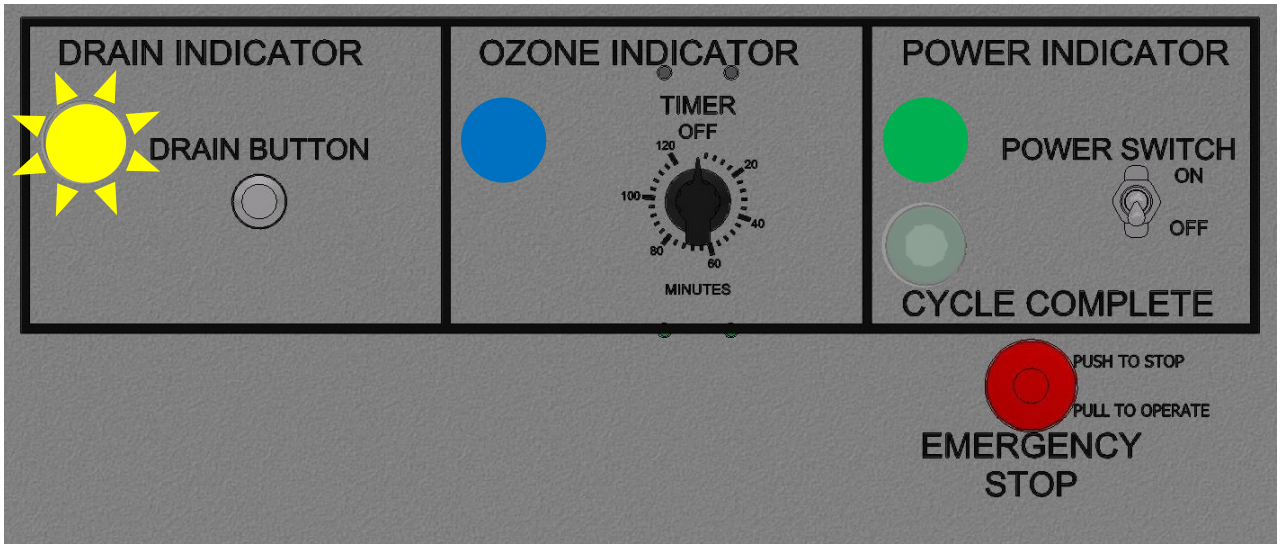
System Running No Ozone

- Power Switch “ON”
- Timer knob active
- Power indicator solid green
- Ozone indicator off
- In this mode the water pump is on, but there is a problem with the ozone system. The AviOzonx system will continue in this mode until the timer completes. The AviOzonx system will need to be serviced to fix the ozone system.



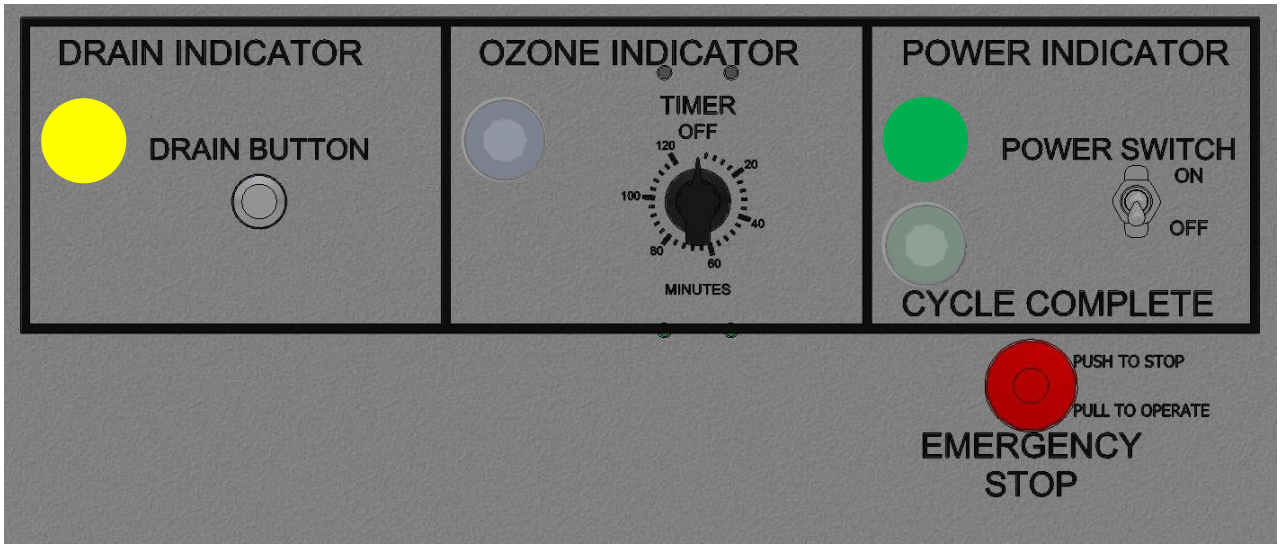
System Running Making Ozone, Will Auto Depressurize the System After Disinfection Cycle Complete

- Power Switch "ON"
- Timer knob active
- Power indicator solid green
- Ozone indicator solid blue
- Drain indicator flashing yellow
- If the drain button is pushed while the timer is active, the drain indicator light will flash yellow indicating that the AviOzonx system will automatically depressurize the lines once the disinfection cycle (timer) is complete.



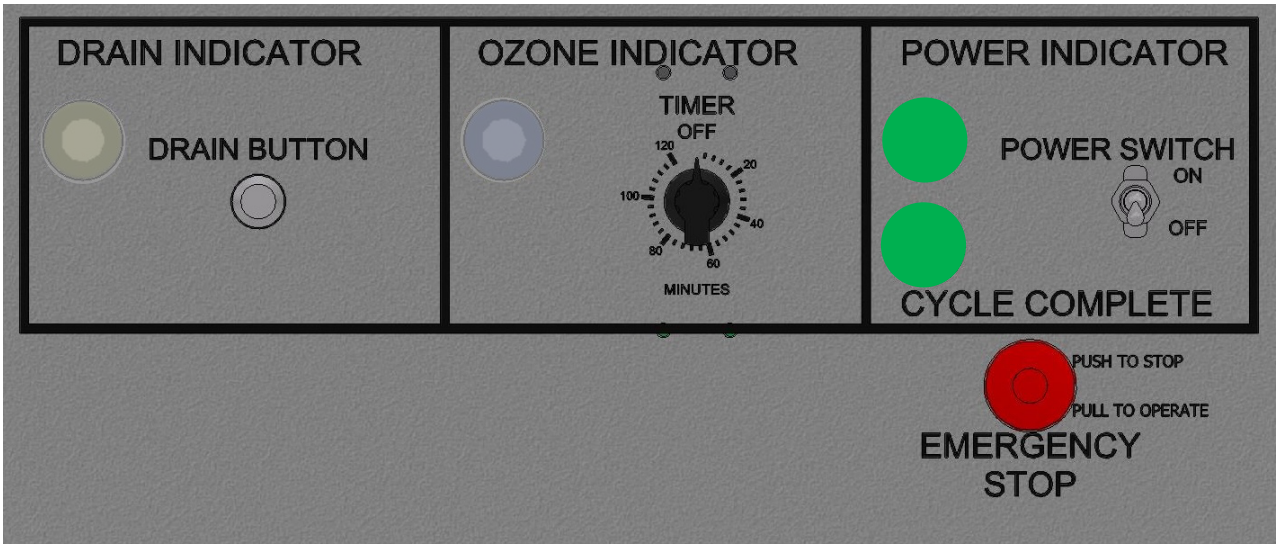
System Depressurizing

- Power Switch "ON"
- Timer knob complete
- Power indicator solid green
- Drain indicator solid yellow
- In this mode the AviOzonx system will automatically open valves and relieve water pressure from the drain and fill lines by sending a little water out the drain line. The water pump will turn briefly and automatically shut off once depressurization is complete.



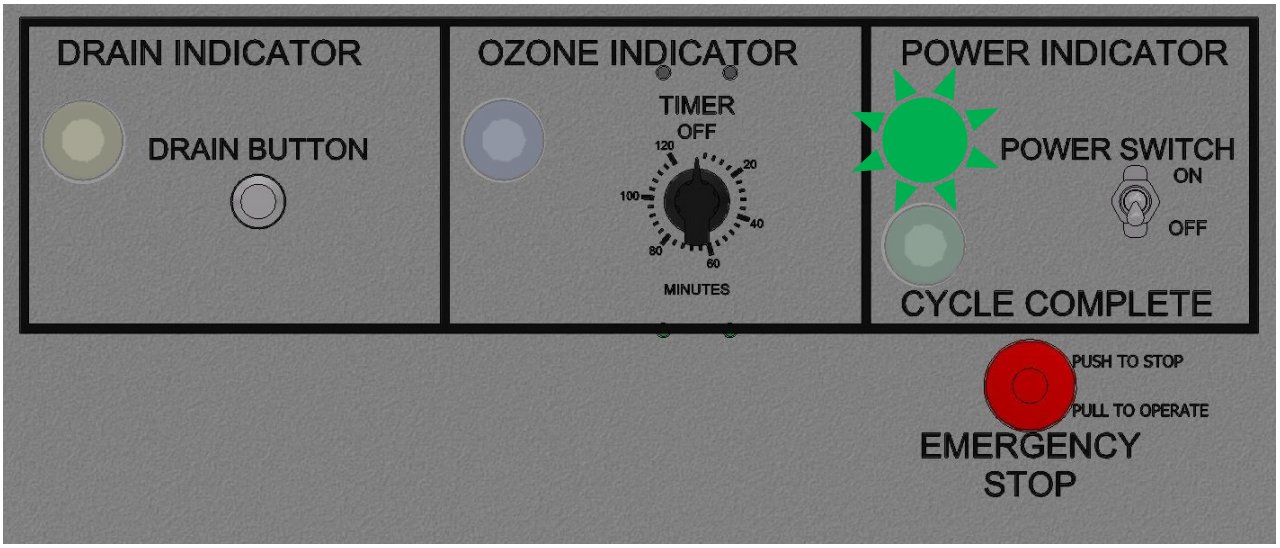
Cycle Complete

- Power Switch “ON”
- Timer knob complete
- Power indicator solid green
- Cycle complete solid green
- Once the AviOzonx system has completed a disinfection cycle (and automatic depressurization if the drain button was pushed), it will automatically shut down the water pump and ozone system and light up the green “Cycle Complete” indicator.



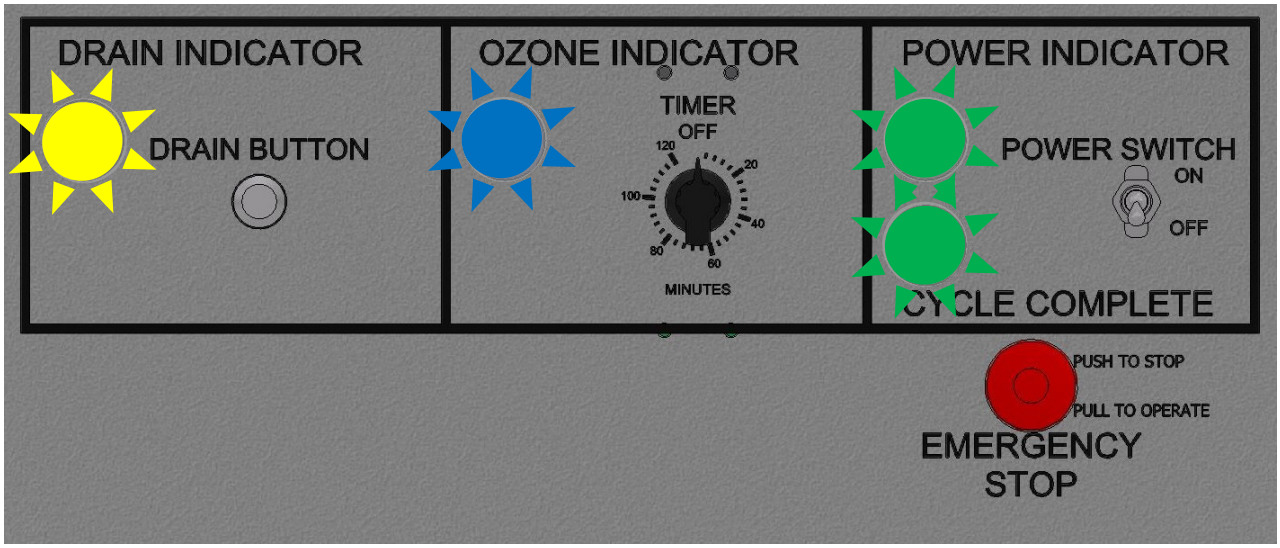
System Depressurizing and Turning Off

- Power Switch “OFF”
- Power indicator flashing green
- If the AviOzonx system is turned “OFF” without being depressurized by pressing the drain button, the AviOzonx system will automatically depressurize before turning “OFF”. While in this mode the power indicator will flash green. Once depressurized the power indicator will turn “OFF”.



Low Inlet Pressure

- Power Switch “ON”
- Timer knob active
- All light blinking
- Once a disinfection cycle is initiated by turning the timer knob, the AviOzonx system will wait for the pressure sensor on the outlet of the water pump to register a minimum of 5 psi before turning on the water pump. If after a few seconds this pressure switch still has not indicated a minimum of 5 psi has been achieved, the AviOzonx system will shut down and begin blinking all the indicator lights. Power will need to be cycled to the AviOzonx to get it out of this mode.
- Low pressure on the outlet of the pump is most likely caused by low inlet water pressure to the AviOzonx system. Make sure a minimum of 20 psi is being supplied to the AviOzonx system. Another possible cause is a failed pressure sensor on the outlet of the pump.



Using the AviOzonx System

ClearWater Tech recommends that all personnel who operate or are working nearby Ozone equipment be trained in the safe use of Ozone. Please contact ClearWater Tech to set up training for your personnel.

Ozone is a highly effective disinfectant; however microbial swabbing should be used to ensure that disinfection levels are at a level that meets the requirements for your application. Typically, a 3-5 log (99.9-99.999%) reduction is recommended. Consult the airline standard operating procedures to verify disinfection cycle times for various aircraft, verify disinfection procedures for the water lines on the aircraft, and find testing protocols to verify successful disinfection of the water system on the aircraft.

Here is an example set of instructions for using the AviOzonx system to treat an aircraft. NOTE: THESE INSTRUCTIONS WERE DEVELOPED FOR A PARTICULAR AIRCRAFT, THEY MIGHT NOT MATCH THE PROCEDURE OUTLINED IN YOUR AIRLINE'S STANDARD OPPERATING PROCEDURE. ALWAYS FOLLOW YOUR AIRLINE'S STANDARD OPERATING PROCEDURE.

Setup & Service Connections

Step 1. Ensure AviOzonx system is on level ground and that the wheels are not prone to drift while in operation. Chock or lock the wheels as needed.

Step 2. Open the Water Service Panel.

Step 3. Remove protective caps from the fill nipples located on the AviOzonx system and hose coupling.

Step 4. Locate the aircraft aft drain port and install the appropriate adapter. See Appendix C for a list of available adapters.

Step 5. Connect the long coupler end of the FILL hose to the drain port on the aircraft.

Step 6. Attach the other end of the FILL hose to the AviOzonx system's FILL port.

Step 7. Locate the aircraft aft overflow port and install the appropriate adapter. See Appendix C for a list of available adapters.

Step 8. Connect one end of the RETURN hose to the overflow port.

Step 9. Attach the other end of the RETURN hose to AviOzonx system's RETURN port.

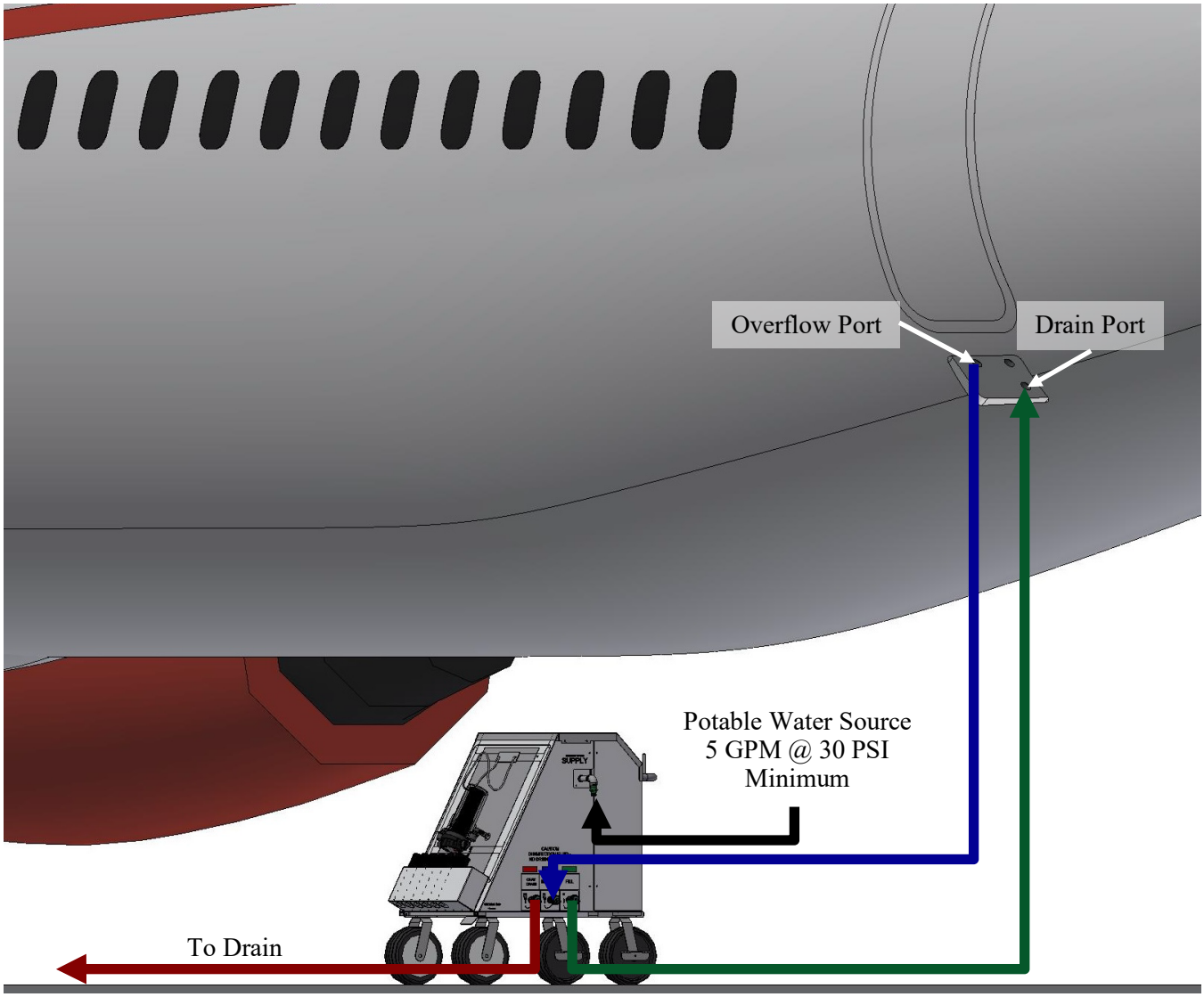
Step 10. Put the aircraft into maintenance mode to allow the water tanks to be completely filled.

Step 11. Connect the source water hose to the AviOzonx system's fitting labeled MUNICIPAL WATER SUPPLY. Do not turn on the water supply at this time.

Step 12. Connect the DRAIN hose to the AviOzonx system's DRAIN port and run the other end to an appropriate facility drain.

AviOzonx Connections

Figure 3



Build Up Ozonated Water in Water Tanks

Step 13. Connect the electrical cord to an appropriate electrical supply.

Step 14. Toggle the AviOzonx system's Main Power switch to "ON". Ensure that the green POWER light is illuminated.

Step 15. Open the water supply valve.

Step 16. Turn the AviOzonx system's timer to the amount of time recommended your airlines disinfection procedure, or use the table on front of the cart to determine the appropriate amount of time to run the cart for the size water tank you are disinfecting..

NOTE: Recirculation will be evident once water is travelling through the line from the Aircraft OVERFLOW port to the AviOzonx system and water is circulating through the AviOzonx system's filter.

Step 17. Ensure that the "OZONE" light is illuminated within one minute of timer activation.

Ozone Testing

Step 18. Once the AviOzonx system's timer has timed out, activate the timer once again to allow the AviOzonx system to pressurize the aircraft's water tanks.

Step 19. Sample shall be taken from galley/lavatory fixtures after 3-5 minutes of continuous running. We recommend using a CHEMetrics photometer to measure the dissolved ozone present in the water in parts per million.

Step 20. In the 25mL sample beaker, put 5 drops of dilution solution provided with the CHEMetrics vacuum vial kit.

Step 21. Fill the sample beaker with 25mL of water from flushed fixture.

Step 22. Take the calibration vial and insert it into the photometer port. With the calibration tube in place, press and hold tester button. The tester shall blink 3 dotted lines and read 0.00.

Step 23. Take the vacuum vial and break off tip in sample beaker. Flip the vial upside down and right side up for 30 seconds to thoroughly mix the solution. The vacuum vial will turn pink in the presence of ozone.

Step 24. Take the test sample vial and insert it into the photometer port. Ensure that the exterior of the vial is dry. Press and hold the test button. The photometer will display the ozone content of the sample.

NOTE: If "E1" is displayed, an error has occurred. Repeat steps 18 through 24.

Step 25. Verify ozone level is between 0.3-0.5ppm. If less than 0.3ppm repeat steps 13-24. If greater than 0.5ppm, the run time in step 16 can be reduced next time.

Disinfect Water System

Step 26. With the AviOzonx system running, go on the aircraft and run water through each coffee maker, lavatory faucet and galley faucet (if installed) for approximately 3-5 minutes, starting in the aft cabin working forward. Run water through the espresso maker(s) if installed. No rinse is needed.

Step 27. Flush toilets.

Disassembly and Stowage

Step 28. Turn off the water supply to the AviOzonx system, close off all valves on the aircraft to isolate the AviOzonx system from the aircraft water supply.

Step 29. Flip the power switch on the AviOzonx systems control panel to "OFF". This will allow the AviOzonx system to depressurize the water lines.

Step 30. Disconnect the RETURN hose from the RETURN port on the AviOzonx system. Disconnect the other end of the RETURN hose from the aircraft aft OVERFLOW port. Completely drain water from the hose and place all caps back on their respective fittings, both on the AviOzonx system ports and the hose.

Step 31. Disconnect the source water hose from the MUNICIPAL WATER SUPPLY port on the AviOzonx system. Completely drain water from the hose and place all caps back on their respective fittings, both on the AviOzonx system ports and the hose.

Step 32. Disconnect the DRAIN hose from the DRAIN port on the AviOzonx system. Completely drain water from the hose and place all caps back on their respective fittings, both on the AviOzonx system ports and the hose.

Step 33. Disconnect the FILL hose from the FILL port on the AviOzonx system.

Step 34. At the water service panel on the aircraft, put the system in drain mode by depressing the DRAIN button. Drain to the desired fill level to ensure no overflow of the system within the airplane upon removing power.

Step 35. Disconnect FILL hose from the aircraft aft DRAIN port. Completely drain water from the hose and place all caps back on their respective fittings, both on the AviOzonx system ports and the hose.

Step 36. Place the system in flight mode.

Step 37. Return aircraft to serviceable condition.

- Disconnect all servicing equipment.
- Close the cap on the aircraft service panel fill nipple.
- Dry the water service panel.
- Ensure the system is in FLIGHT mode.
- Close the water service panel door.
- Stow all the hoses on the hangar hook located on the AviOzonx system.
- Unplug the AviOzonx system's electrical cord of the from the power source.

Step 38. Drain the residual water from the drain bowser to a sanitary drain or acceptable alternate.

Step 39. Store AviOzonx system in an environment that is maintained at a temperature that is above +32°F (+2°C) and +140°F (+60°C).

NOTE: AVIOZONX SYSTEM AND AVIOZONX HOSES MUST BE COMPLETELY DRAINED OF WATER PRIOR TO STORING AT FREEZING TEMPERATURES.

Maintenance

Maintenance of the AviOzonx 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: weekly, monthly, annual and three-year. Weekly procedures involve quick, visual checks for changes in normal operating conditions. Monthly, annual and three-year 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 the 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" section before attempting any maintenance procedure that requires the use of tools and/or shutting down the ozone system.**

Refer to the Airline Operational Video for identification of components and testing procedures, as well as startup and shut down procedures.

Weekly Procedures

Check For a Complete Cycle

- Observe AviOzonx system for a complete cycle to make sure operation is as expected (connected to airplane)

Monthly Procedures

Check System Pneumatics

1. Between 6-10 SCFH on the Oxygen Flow Meter
2. Between negative 10 and positive 10 on the multicolored Pressure Gauge (depending on mode)
3. Between 20-30psi on the pump inlet
4. Between 10-80psi on the pump outlet on fill, between 80-90psi on the pump outlet on recirculation
5. Between 0-45psi on the top of the Venturi injector on fill, between 40-50psi on the top of the Venturi injector on recirculation

Check FLT34 Moisture Indicator

- The indicator is normally a rich blue. Pink, orange, or white would indicate moisture is beginning to develop. Refer to the "Check Oxygen Purity" section if this is the case.

FLT34SA Particulate Filter

Figure 4

Check Tire Pressure

- Fill to 50PSI

Check Water Filter

1. Inspect filter element to be clean – *a clogged or dirty water filter can affect outlet pressure and potentially cause unit to AviOzonx system to shut down to prevent overheating*

Check for any water leaks around all fittings and connections

Check Cooling Fans

- Make sure operational – if nonfunctioning, check wiring connections, replace fan if required

Annual Procedures

Rebuild Ozone Reaction Chamber

Refer to the following Pressure Reaction Chamber Rebuild Video and Vacuum Chamber Rebuild Videos

***** AviOzonx systems use Vacuum Chambers – included is Pressure Chamber video as it has thorough cleaning instructions and applies to both types of chambers***

Optionally replace Reaction Chamber with Refurb Exchange Chamber RCC7SARM

<u>CAUTION:</u> Unplug the AviOzonx system before performing any of the following steps.

Reaction Chamber 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: Unplug the AviOzonx system.

Step 2: Disconnect tubing connections from the fittings on both ends of the reaction chamber.

Step 3: Disconnect the high voltage lead from the drive transformer.

Step 4: Remove the nuts holding the reaction chamber to the chassis.

Step 5: Remove reaction chambers from the system.

Step 6: Remove retaining screws and washers from the two end caps (4 each) of the reaction chambers.

Step 7: 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: Orientation of the end cap on the heat sink/cathode assembly.

Step 8: 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 9: With contact brush attached, remove the brush adapter nut from the high voltage end cap.

Step 10: Inspect the dielectric, end caps and cathode for breakage, corrosion or debris. Clean and/or replace parts as necessary. Re-assemble the reaction chamber per the instructions below.

Reaction Chamber Assembly and Re-installation

Step 1: Make sure the glass dielectric is clean (free of dust, dirt, grease, oils, etc.).

Step 2: Prepare the end caps for re-assembly by replacing the O-rings. Thread the hex brush adapter nut, with contact brush attached, onto the end of the high voltage end cap (cap with the white power lead attached) center screw.

Step 3: Using a gentle twisting motion, press the non-high voltage end cap onto the heat sink/cathode assembly until flush with the heat sink cooling fins.

Note: Orientation of the end cap on the heat sink/cathode assembly.

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.

Note: Do not deform the end cap material with the screw.

Step 5: Roll the high voltage anode (foil-like material) lengthwise, preserving the longer dimension. Insert the rolled anode into the dielectric. Center the anode in the dielectric (approximately 1/2" from either end of the glass), making sure it is rolled squarely.

Step 6: Slide the dielectric into the heat sink/cathode assembly. Seat the dielectric into the O-rings of the non-high voltage end cap by applying pressure with a gentle twisting motion. (There must not be any dirt, debris, oils or fingerprints on the dielectric upon re-installation).

Step 7: *Slowly* insert the high voltage end cap assembly into the dielectric.

Note: Do not bend center wire of the brush during this procedure.

It is normal for the bristles to bend. Using a gentle twisting motion, press the high voltage end cap onto the heat sink/cathode assembly until flush with the heat sink cooling fins.

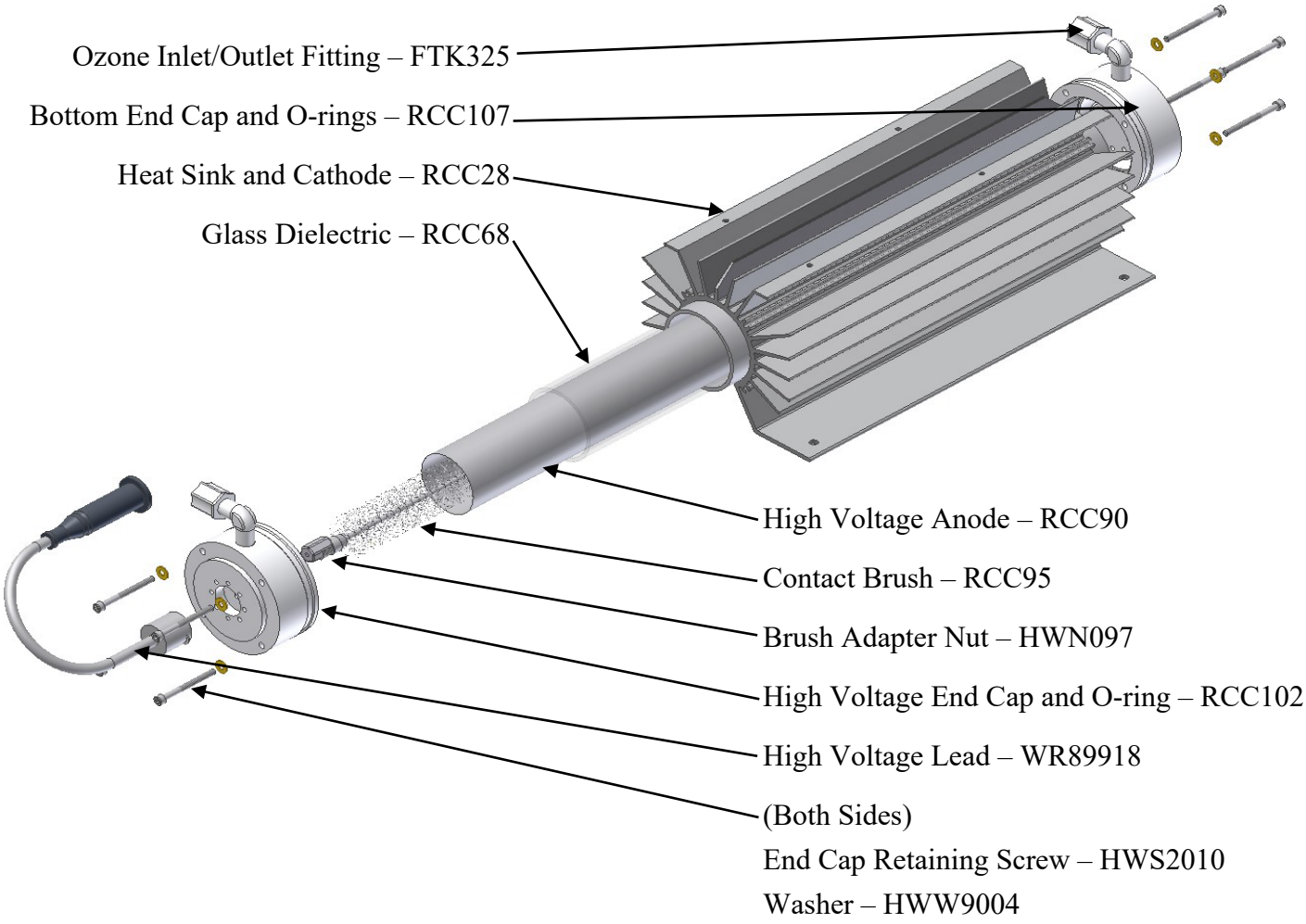
Note: Orientation of the end cap on the heat sink/cathode assembly.

Step 8: Slide the four end cap retaining screws through the holes in the end cap, aligning them with the heat sink screw bosses. Thread screws into screw bosses until heads are snug against the end cap.

Step 9: Re-install complete reaction chamber assembly into the ozone generator, reconnect the high voltage lead(s) and tubing connections to both end caps.

Reaction Chamber – Exploded View

Figure 5



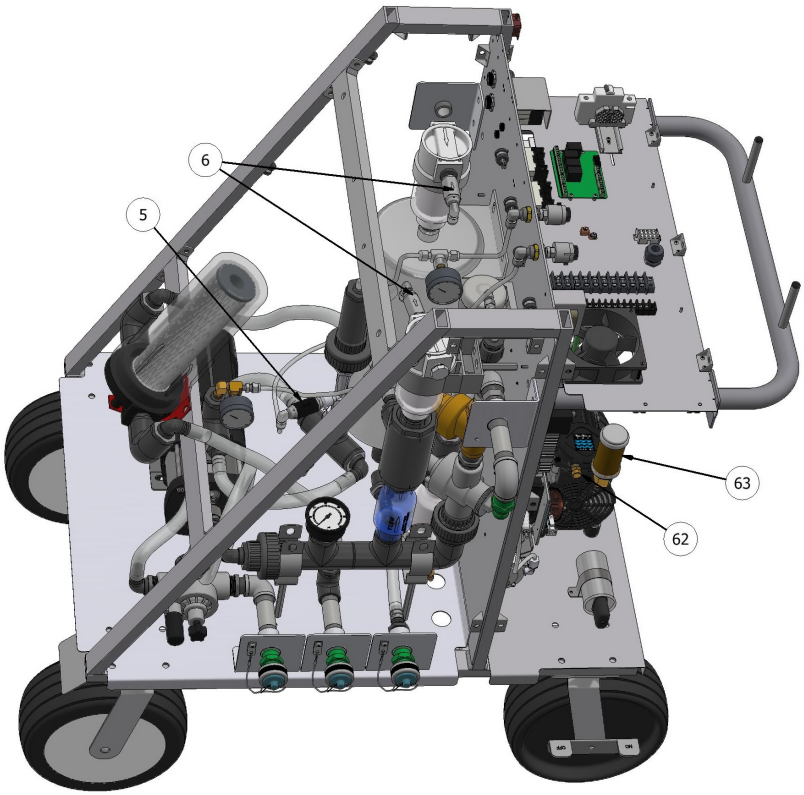
Check Oxygen Purity

1. Using an oxygen meter, test the oxygen purity level. If the purity is found to be low the acceptable levels, further troubleshooting must be completed. If immediate troubleshooting cannot be done the system should be shut down until it is possible. Degradation level of the oxygen sieve bed can be found based on the level of oxygen purity, see chart below.

Oxygen Purity	88% +	40% - 87%	Below 40%
Action	Oxygen sieve bed is in good condition, no action required	If no further issues are found, perform a recovery purge cycle. See the Troubleshooting section.	If no further issues are found, the oxygen sieve bed may need to be replaced

Location of Components to Replace

Figure 6



Replace Components

- Check Valves
    1. Check Valve (#6), on outlet of contact tank off-gas vent.
    2. Check Valve (#6), on outlet of return line off-gas vent.
    3. Check Valve (#5), on inlet of venturi injector.
- Oxygen Pressure Relief Valve (PRV)
    1. Verify power has been disconnect from the AviOzonx system.
    2. Allow air to purge from all lines and release any remaining pressure in the system.
    3. Remove the existing PRV (#62) by unthreading it counterclockwise.
    4. Apply several wraps of Teflon® tape to the threads of the new PRV.
    5. Install the new PRV and tighten.

    NOTE: Do not over tighten. Over tightening may crack the compressor head.
- Oxygen Air Intake Filter
    1. Verify power has been disconnect from the AviOzonx system.
    2. Allow air to purge from all lines and release any remaining pressure in the system.
    3. Remove the existing air intake filter (#63) by untreading it counterclockwise.
    4. Apply several wraps of Teflon® tape to the threads of the new filter.
    5. Install the new filter and high tighten.

Every 3 Years

Rebuild Compressor

Refer to manufacturer's rebuild kit instructions

1. Verify power has been disconnect from the AviOzonx system.
2. Allow air to purge from all lines and release any remaining pressure in the system.
3. Disconnect the cooling-coil from the compressor.

   NOTE: Be careful not to bend or fold the aluminum cooling coil.
4. Mark the orientation of intake and exhaust ports of the compressor heads, so each cover can be reinstalled in the correct orientation.
5. Remove each screw from both heads of the compressor.
6. Mark the orientation of each valve-plate. Remove each valve-plate by lifting vertically.
7. Remove each cylinder sleeve
8. Remove each piston head by unthreading the retaining screw(s). This will reveal the old piston cups.
9. Remove and discard the old piston cups, cylinder O-rings, head O-rings, retainer screws, valve reeds, and valve retainers.
10. Clean the cylinder sleeves and the valve seats with a water-based solvent to remove debris. The cylinders may be reused if not too worn. Take care not to score the surface of these items while cleaning.
11. Reinstall retainer cups and piston heads in their proper orientation. Secure with the provided screws.
12. Carefully install cylinders over the cups at an angle to avoid damaging the cups. Using a circular motion is often helpful.
13. Note the orientation of the reeds on both reed plates.
14. Examine the reed plates for any debris and clean with a water-based solvent after removing the old reeds and retainer.
15. Reinstall your new reeds and retainer, paying close attention to their order and orientation. Also make sure the square retaining washer is square to the reeds and not turned.

    NOTE: The reed hinges on this point and if not squared, it can prematurely break the reeds.
16. Hand tighten both reed sides of the plate.
17. Replace both the circular gaskets and both head sealing gaskets on each plate. Seat the circular gasket side of the plate down onto the rims of each cylinder.

    NOTE: Make sure the gasket is seated properly. Take care not to pinch the gasket.
18. Place the compressor heads back onto the plates, aligning the head with the head gaskets. Again, make sure no parts of the gasket are out of alignment and are at risk of pinching. Note: Correct orientation of the heads to the compressor.
19. Once aligned, secure each compressor head with the screws.
20. Reattach the cooling-coil and secure.

As Necessary

Rebuild Solenoid Valve

Refer to the following Solenoid Rebuild Video

1. Verify power has been disconnect from the AviOzonx system.
2. Allow air to purge from all lines and release any remaining pressure in the system.
3. Unscrew the hex nut at the top of the solenoid valve in a counterclockwise direction.
4. Lift the black solenoid valve coil upwards and off the shaft of the solenoid. Set aside for now.
5. Use the hex removal tool included in your solenoid rebuild kit to remove the solenoid shaft. The studs on the removal tool should align with the dimples on your solenoid shaft base. Unthread the stem out in a counterclockwise direction.
6. Remove the old shuttle core and spring and discard.
7. Remove the old gasket o-ring from the solenoid body.
8. For re-installation, reverse steps 1-8.

Replace Oxygen Sieve Bed

For Sequal oxygen systems on systems manufactured before 2021

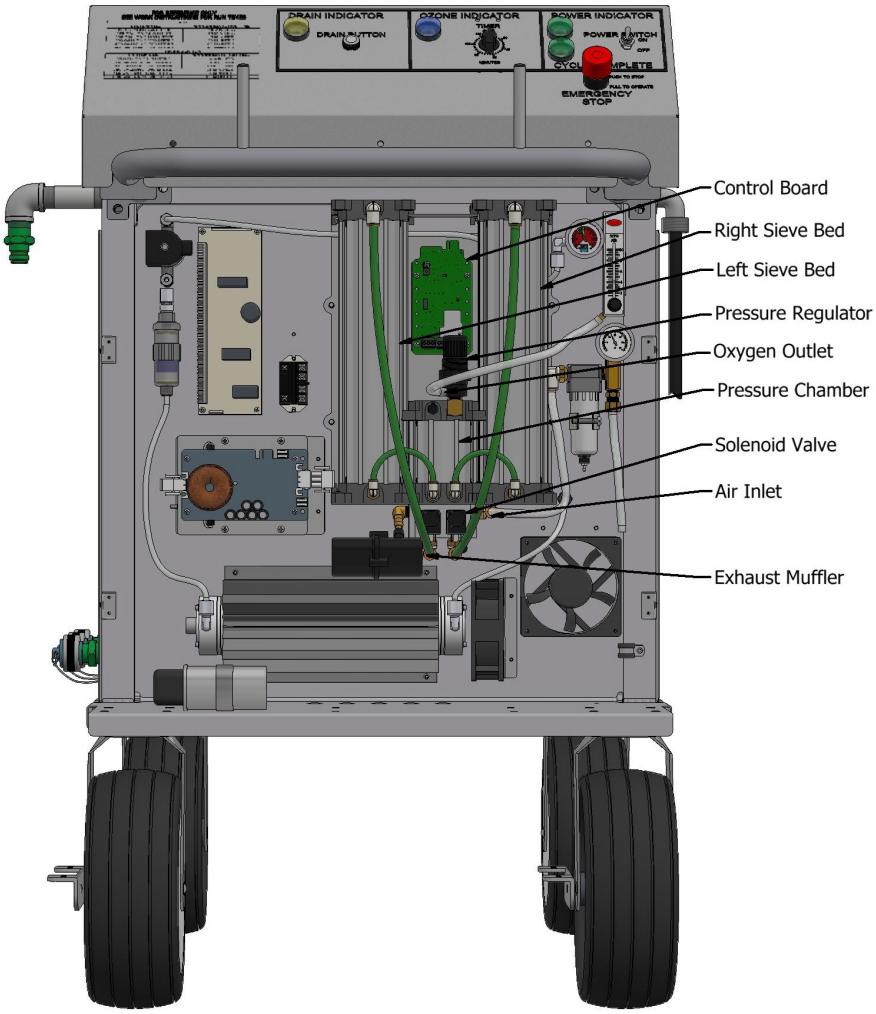
1. Verify power has been disconnect from the AviOzonx system.
2. Allow air to purge from all lines and release any remaining pressure in the system.
3. Remove the large grey tubing from the base of the oxygen sieve bed module by untightening the hose clamp.
4. Remove the large clear braided tubing from the oxygen sieve bed module by untightening the hose clamp.
5. Disconnect the white electrical connector at the base of the oxygen sieve bed module
6. Unbolt the bracket at rear (top side) of the module. This should free the oxygen sieve bed module from the back panel of the system.
7. Transfer the bracket to your new ATF and reverse steps 3-6.

For AEROUSnx system on AviOzonx systems manufactured in 2021 and later

In 2021 the oxygen system was upgraded in all AviOzonx systems to the AEROUSnx system. Systems manufactured 2021 and later have this new system with the following components. The Sieve Beds in upgraded system are replaced as an assembly.

AEROUSnx Oxygen System

Figure 7



Service the Auto Off-Gas Vent

1. Verify power has been disconnect from the AviOzonx system.
2. Allow air to purge from all lines and release any remaining pressure in the system.
3. Remove the off-gas vent by unscrewing counterclockwise at the base.
4. Separate the top of the off-gas vent from clear base by unscrewing the top counterclockwise.
5. A toothbrush and clean water should work well to agitate and loosen any large debris.
6. Inspect the stainless float for any damage.
7. Inspect the vent exit port to ensure this is clear of debris. Clean or replace as required.
8. Inspect the large O-ring which seals the clear bowl to the top section.
9. To reassemble, reverse steps 1 – 4.

Rebuild/Replace Pump

Rebuild the water boost pump per the manufacturer's instructions. If the pump cannot be rebuilt, replace as required

Troubleshooting

Main Power

Problem/Symptom	Possible Cause	Solution
Unit not operating	• No power to system • Power switch in "OFF" position • GFCI is tripped • Cover safety switch is not engaged • Emergency Stop button engaged • Main Breaker (internal) tripped	• Check main power to system • Flip power switch to "ON" position • Press the "RESET" button on the GFCI unit • Ensure the control panel is secured • Reset the emergency stop button • Check the main breaker, reset if necessary
GFCI trip upon startup	• A generate is being used to power the AviOzonx system • Loose wire • Water pump has failed • Oxygen concentrator has failed • Power supply problems • Compressor cooling fan failure	• Power the AviOzonx system from a wall outlet • Check all terminal strip connections • Test pump by manually triggering the relay • Test the oxygen concentrator by manually triggering the relay • Inspect the power supplies • Inspect the cooling fans

Control Panel

Problem/Symptom	Possible Cause	Solution
No lights on panel	• No power to the AviOzonx system • Control panel cover switch not engaged	• Check source power and GFCI • Engage cover switch
Control panel lights blinking	• Pump outlet pressure too low (below 5 psi) • Left most pressure switch failure	• Increase water supply pressure to pump • Inspect pressure switch for operation (wires #26 and #27)
Timer not counting down	• Timer may be disconnected • Timer may be damaged	• Inspect and replace timer if necessary
Drain button not working	• Pump outlet pressure too low (below 5 psi)	• Ensure water supply to pump

Ozone Generator

Problem/Symptom	Possible Cause	Solution
Drive Board 12V Main Power, "Green" LED not illuminated	• No power to drive module from power supply	• Check main power to drive module • Test voltage from power supply to drive module, see Appendix G
Drive Board Transformer (XFMR) Power, "Green" LED not illuminated	• If drive board "Main Power" LED is not illuminated, the "XFMR Power" LED will not illuminate • Blown drive board "on board" fuse • Drive board is in "Fault" mode	• Test voltage from power supply to drive module, see Appendix G • Replace "on board" fuse • See Troubleshooting, "Fault" LED

Ozone Generator – Continued

Drive Board Ozone Output, "Amber" LED not illuminated	• If the Transformer (XFMR) Power LED is not illuminated, the "Ozone Output" LED will not illuminate • Drive board is in "Fault" mode	• Check all wires and connectors • See Troubleshooting, "Fault" LED
Drive Board System Fault – Solid Light, no Flash	• Bad drive board. A fault condition always flashes to indicate the problem.	• Replace drive board
Drive Board System Fault – Single Flash The drive board cannot get enough power into the reaction chamber.	• Loose wire harness connection from the drive board to the drive transformer • Drive board incorrectly characterized the system on startup • Loose or disconnected High Voltage Lead to transformer • Excessive dirt or debris in ozone reaction chamber • Water in ozone reaction chamber • Broken dielectric • Failed drive board • Failed drive transformer	• Check all wires and connectors • With pressure and flow at normal operating conditions, restart the ozone generator. • Attach High Voltage Lead to transformer • Clean the dielectric and replace O-rings • Clean the dielectric and replace O-rings • Replace dielectric • Replace drive board • Replace drive transformer
Drive Board System Fault – Double Flash The drive board's feedback had a series of sudden dips indicative of unusual arcing occurring somewhere in the system.	• Loose wire harness connection from the drive board to the drive transformer • Loose or disconnected High Voltage Lead to transformer • Excessive dirt or debris in ozone reaction chamber • Water in ozone reaction chamber • Broken dielectric • Failed drive board • Failed drive transformer	• Check all wires and connectors • Attach High Voltage Lead to transformer • Clean the dielectric and replace O-rings • Clean the dielectric and replace O-rings • Replace dielectric • Replace drive board • Replace drive transformer. If when you shake the transformer next to your ear you hear liquid sloshing, this means air has gotten into the transformer and it needs to be replaced.
Drive Board System Fault – Triple Flash The thermal switch on the board has closed indicating that it was exposed to temperatures exceeding 140F.	• Unit is overheating	• Check fan for proper operation and clean fan filter • Check operating temperature
Drive Board System Fault – Quadruple Flash There might be a problem with the 48-volt power rail.	• Malfunctioning Power Supply	• Check voltage going into the drive board when drive board is attempting to run and when drive board is in fault. • If one of the power supplies is producing less than 22volts, replace
Fan not operating	• Fan obstructed • Fan inoperable	• Remove obstruction • Replace fan

Ozone Generator – Continued

Ozone smell detected from or near ozone generator	• Loose internal fittings • Defective O-ring seals in reaction chamber • Defective dielectrics	• Check all fittings, tighten as required • Check & replace as required • Check & replace as required

Air Preparation

Problem/Symptom	Possible Cause	Solution
Unit not operating	• No power to system • GFCI is tripped • Main Breaker on the Control panel is tripped • Power switch if OFF • Compressor not functioning	• Check main power to system • Press the "Reset" button on the GFCI unit • Check the Main Breaker, reset if necessary • Switch the power "ON" • Rebuild or replace as required
Compressor pressure lower than expected range (15psi – 28psi)	• Air leaks • Solenoid valve not operating properly • Coalescing filter leaking • Fouled compressor inlet filter • Compressor not functioning	• Check for leaks using soapy water, tighten fittings, replace tubing as necessary • Check the function of the solenoid valve, disconnect hoses and check for air flow. Solenoid valve will need a small amount of back pressure to operate properly. Replace as necessary • Check for leaks using soapy water, replace as necessary • Replace inlet filter • Rebuild compressor or replace as required.
Compressor pressure higher than expected range (15psi – 28psi)	• Pinched hoses • Solenoid valve not operating properly • Sieve bed material is saturated with moisture	• Check hoses • Check the function of the solenoid valve, disconnect hoses and check for air flow. Solenoid valve will need a small amount of back pressure to operate properly. Replace as necessary • Check the weight of the sieve bed, replace as necessary
Vacuum on ozone cell gauge less than expected during initial tank fill	• Air leaks • Poor water pressure across venturi injector • Airflow is too high	• Check for loose fittings or damaged tubing. Replace as necessary. • Check the water pump outlet pressure and tank pressure while the system is running. Ensure there is a ~40psi difference between the two gauges • Adjust the air flow on the air flow gauge to the right until the air flow is 10 CFH.
Oxygen flow gauge is out of expected range (10 CFH)	• Flow meter out of adjustment • Fouled compressor inlet filter • Compressor not functioning • Air leak	• Adjust flow meter needle valve • Replace inlet filter • Rebuild compressor or replace as required • Check & tighten fittings

Air Preparation – Continued

Compressor pressure relief valve making noise	• Pressure relief valve not operating • Pinched tubing • Compressor not functioning • Sieve bed not operating	• Replace pressure relief valve • Replace tubing • Rebuild compressor or replace as required • Repair or replace sieve bed as required

Water Circulation – Tanks, Valves, Pump, Etc.

Problem/Symptom	Possible Cause	Solution
Water overflowing at off-gas vent	• Debris stuck in vent exit port preventing proper closure • Damaged float mechanism	• Remove vent and flush out debris • Confirm water separator operation • Inspect release valve hinges and float
Pump Not Working	• Water pressure too low on pump outlet • Pump not wired correctly • Pump relay failed • Pump pressure switch failed	• Increase water supply pressure to pump (30 psi minimum) • Confirm pump wired correctly • Test relay, replace if necessary • Test pressure switch, replace if necessary
Solenoid Valves Not Responding	• AC transformer (#61) failed	• Test transformer, replace if necessary

Specific Trouble Shooting Procedures

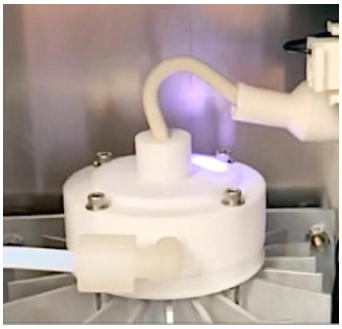
Oxygen Sieve Bed Recovery Purge Cycle

- Test the oxygen purity level to create an oxygen purity baseline. This will require removing the oxygen feed line running to the ozone reaction chamber.
- Power down the unit.
- Temporarily move wire #14 to the adjacent terminal so wire #14 is contacting wire #31. This will force the oxygen system to be on.
- Disable the ozone system by removing the three-position power connector going to the ozone drive board (See Appendix G).
- Close the oxygen output SCFH needle valve completely.
- Apply power to the AviOzonx system and run the oxygen concentrator for a minimum of 24-hours.
- Test the oxygen purity again.
- If the oxygen purity level has increased to 88% or greater, the oxygen sieve bed has been recovered, if the oxygen purity level has increased, though not up to 88%, run the recovery cycle for another 24 hours.
- If an increase in purity is observed after each 24-hour period, the recovery cycle may be continued. If the oxygen purity level is not increasing after one or two attempts, then the oxygen sieve bed must be replaced.

Bypassing the drive board fault mode (for testing purposes ONLY)

- Power down the unit.
- Locate black jumper connection labeled “W1” on board (See Appendix G).
- Short these terminals. This can be achieved with a light gauge wire wrap, alligator clips, or appropriate jumper
- Try to eliminate as much ambient light as possible around the ozone chamber

- Apply power to AviOzonx system, turn “ON”, and begin timer
- Observe function of lights on the board and the end caps of the reaction chamber
  - If glowing or flashing begins within either of the reaction chamber end caps (see picture to the right), shutdown the AviOzonx system immediately. Inspect and/or replace glass
  - If no glowing is observed, make note of what the ozone system sounds like as it started up, shut down the system, and contact our service team for further assistance



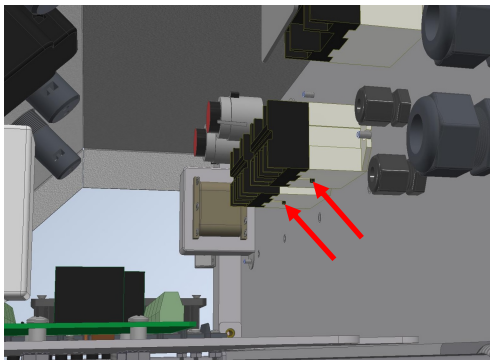
GFCI Power Troubleshooting

Using a portable generator

- Using a portable generator with the AviOzonx system can cause the GFCI to trip AviOzonx system. It is recommended to use the AviOzonx system while connected to power from a wall outlet. If a portable generator is required, we recommend removing the GFCI from the AviOzonx system’s power cord and purchasing a generator with a built in GFCI.

Wall Power

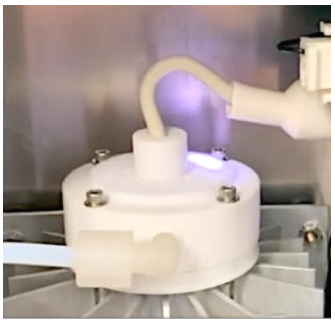
- Ensure the electrical GFCI on the power cord is operational and the grounding prong is intact. To test for GFCI trips, try to power components individually to see if the GFCI trips when a particular component is powered.
- Each of the relays can be triggered manually by pressing and holding the test pin on the underside of the relay as shown in the picture at right. One relay controls the water pump. Another controls the Ozone Generator. If either of these cause the GFCI to trip when triggered, investigate that circuit thoroughly.
- Loose wire connections can cause GFCIs to trip. Check all terminal strip connections to verify screws are tightened properly.



Reaction Chamber Inspection

Exterior inspection:

- Confirm the white high voltage wire that connects to the top of a reaction chamber is not touching the chassis or any other metal component.
- During ozone production, no glow or flickering light should be visible within the white Teflon endcaps
  - If light is seen, this is a sign of damaged dielectric glass. Typically, the dielectric glass is broken, and if the end cap is likely damaged as well.



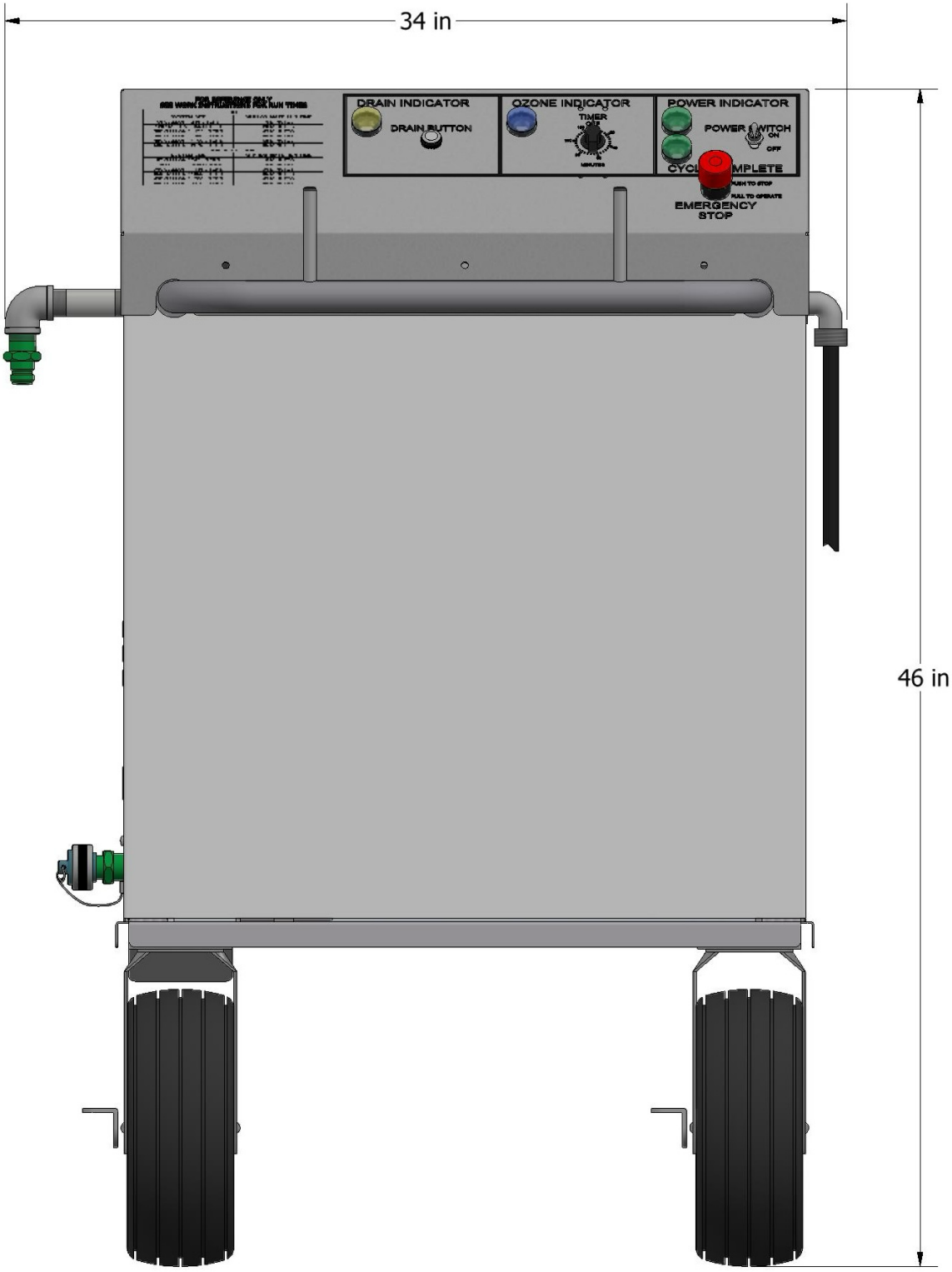
Interior inspection:

1. Verify power has been disconnect from the AviOzonx system.
2. Allow air to purge from all lines and release any remaining pressure in the system.
3. Disconnect the high voltage wire from the transformer.
4. Disconnect the tubing connections on both ends of the reaction chamber.
5. Remove the 4 nuts securing the chamber and remove the reaction chamber from the AviOzonx system.

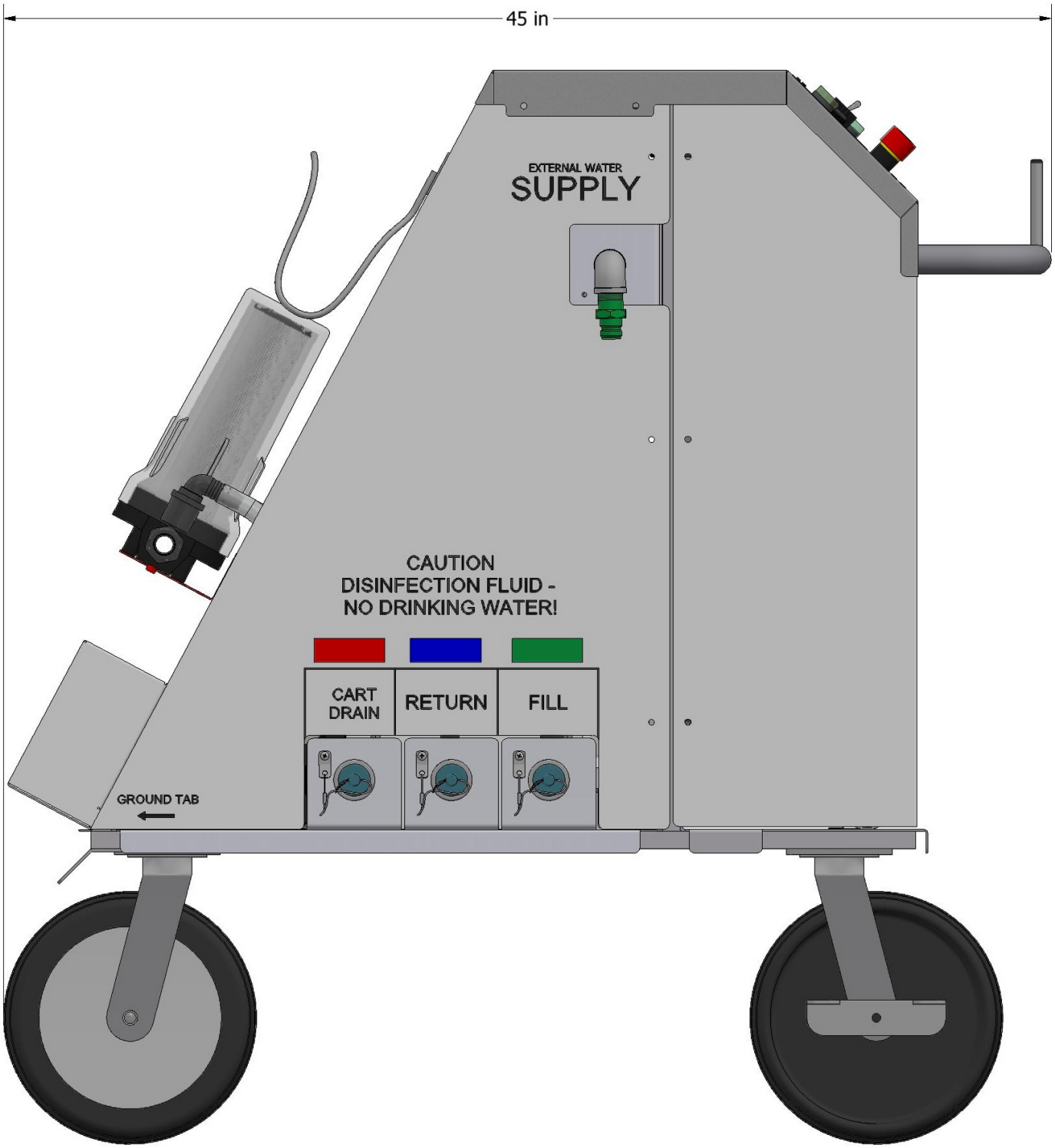
6. Make note or mark the position of the end caps and their elbow fittings on the reaction chambers, during reassembly the end caps will need to return to original positions.
7. Remove retaining screws and washers from both end caps (4 each).
8. Using a gentle back-and-forth twisting motion, remove the non-high voltage endcap (the one without the high voltage attachment screw) from the heat sink/cathode assembly.
9. A flat-head screwdriver may be used to gently pry the endcap off, ensure equal pressure is applied to each side of the end cap.
10. Remove the high voltage end cap and dielectric from the heatsink/cathode assembly.
11. The dielectric glass will be attached to the high voltage end cap, leave it connected for now.
12. Inspect for damage
    - The dielectric glass should not be cracked/broken
    - The brush, visible through the glass, can be discolored without effecting the ozone output
    - Teflon end caps should not be scorched, blackened, or have jagged cuts within it.
    - O-rings should be unbroken on both interior and exterior sets.
13. Clean any moisture or nitric acid found on the exterior of the dielectric glass and interior of the heat sink and cathode assembly.
    - Denatured alcohol and/or a simple clean rag can be used.
14. Assuming no damage is noted, reassemble the reaction chamber by installing the non-high voltage endcap to the heat sink cathode assembly.
15. Ensure no fingerprints or dampness are on the dielectric glass and reinstall into the heatsink cathode assembly, securing the non-high voltage endcap to keep it from pushing out.
16. Rotate the endcaps to their original positions and reinstall retaining screws
17. Reinstall assembled reaction chamber into the AviOzonx system, connect grounding nuts, tubing and high voltage wire connections.

Appendix A – Specifications

Front View



Side View


45 in
EXTERNAL WATER
SUPPLY
CAUTION
DISINFECTION FLUID -
NO DRINKING WATER!
CART
DRAIN
RETURN
FILL
GROUND TAB

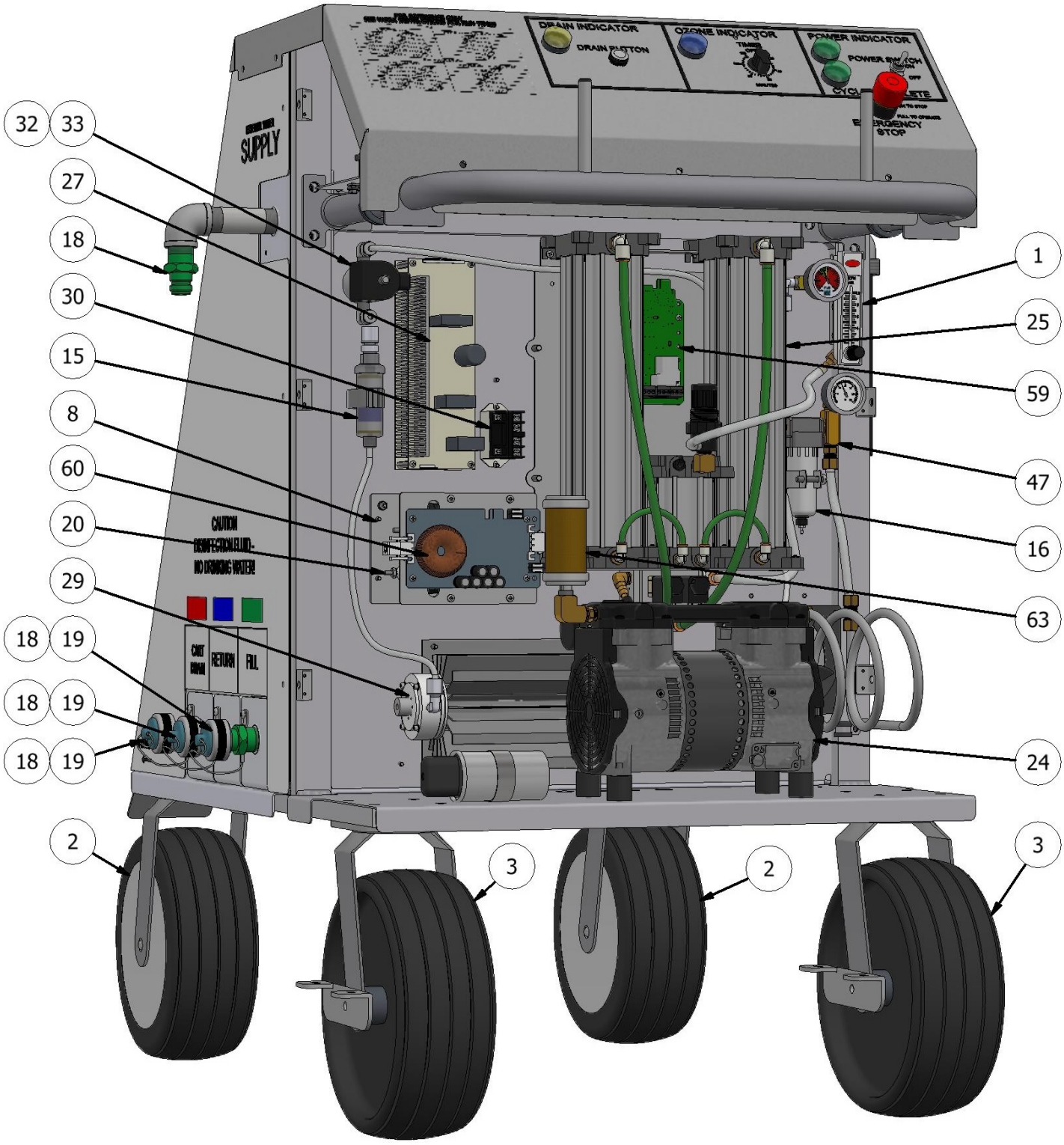
AviOzonx System Specifications

Models	AWD204 – 120V Without Casters AWD204W – 120V With Casters AWD206 – 220V Without Casters AWD206W – 22V With Casters
Main Power	AWD204(W): 120 VAC 60 Hz, 20 amps AWD206(W): 220 VAC 50 Hz, 11 amps
Power Cord	100 feet with GFCI
Dissolved Ozone	4 ppm @ 10 GPM
Ozone Gas	11.6 g/hr @ 10 SCFH, 2.8% concentration by weight
Oxygen Gas	>90% +/- 3% Oxygen @ 15 SCFH
Water Inlet Pressure	20-300 psi
Water Inlet Flow	5 GPM minimum
Water Inlet Temperature	100 °F maximum
Water Inlet pH	7.0 to 7.6 pH for maximum Ozone output
Water Connections	Waterfill Quick Connect ¾ in male fittings for water inlet/outlets
Outside Indicators	Power On Ozone On Drain/Depressurization Cycle Complete
Inside Indicators	Oxygen Flow Gauge Compressed Air Pressure Oxygen Pressure Inlet Water Pressure Pump Outlet Pressure System Outlet Pressure.
Controls	Power On/Off Switch, Timer, Drain/Depressurization Button
Outside Dimensions	46 in H X 34 in W X 45 in D 117cm H X 86 cm W X 114 cm D
Weight	370 lbs (168 kg)
Options	Water Hoses Dissolved Ozone Test Kit

Appendix B – Parts List

#	Description	Part Number
1	Flowmeter	ACXFLOW
2	Caster – Rigid, 10in	CAS10
3	Caster – Swivel Break, 10in	CAS12
4	Service Assembly – AviOzonx System Control Board	CCA1347SA
5	Check Valve – PVC ¼ FPT X ¼ FPT, 1 lb check, Aflas Seal	CHV21
6	Check Valve – PVC ¼ MPT X ¼ FPT, 1 lb check	CHV22
7	Power Cord – 120V, 100FT	CRD964
8	Service Assembly – HO Drive Module	DRM12SA
9	Circuit Breaker – 20 Amp, DIN Rail Mount	ECC320
10	GFCI Inline – 120V	ECC655
	GFCI Inline – 230V	ECC656
11	Fan – 4in 120V 50/60Hz	FA41
	Fan – 4in 240V 50/60Hz	FA42
12	Water Filter Housing – ¾in FPT	FLT100
13	Water Filter Element	FTL101
14	Water Filter Viton O-Ring	FLT102
15	Air Inline Particle Filter	FLT34SA
16	Coalescing Filter – 4 CFM, ¼ FPT, Auto Drain	FLT75
17	Fitting – 316 Stainless Steel – ¾ in Hex Nipple	FTS427
18	Fitting – Quick Connect Nipple	FTS460
19	Fitting – Quick Connect Cap	FTS465
20	HO Transformer – High Voltage Step Up	HVT275SA
21	Indicator Light – 24V Green	INL60
22	Indicator Light – 24V Blue	INL61
23	Indicator Light – 24V Yellow	INL67
24	Compressor – Oil-less 3.5 CFM at 30psi, 120/240V 50/60Hz	AC115
25	Sieve Bed Assembly – CWT Sieve Bed with Control Board	OX906
26	Pressure Regulator – ¾ inch Bronze	PRV752
27	Power Supply – Regulated, 150W, 24 DC, Open Frame	PSR820
28	Pump – 1.05 HP 1 Phase 115/230V 60Hz	PUP60
	Pump – 1.05 HP 1 Phase 230V 50Hz	PUP65
29	Refurbished CD Chamber – Complete 2in REV 3, 90 Deg In/Out	RCC7SARM
30	Relay – 6 Pin, DPST, 120V Coil, Screw Type	REL21
	Relay – 6 Pin, DPST, 240V Coil, Screw Type	REL22

31	Relay – 6 Pin, DPST, 24V Coil, Screw Type	REL23
32	Solenoid Valve – 7000 Series, 2 Way Stainless Steel, Valve Only	SV102
33	Solenoid Valve – 7000 Series, 120V Coil Only	SV300
	Solenoid Valve – 7000 Series, 240V Coil Only	SV310
34	Solenoid Valve – 2 Way PVC, Water, 24VAC 60Hz	SV700
35	Pressure Switch – 3-100 psi, 1/8 MPT, Stainless Steel	SWT115
36	Toggle Switch – SPST	SWT190
37	Emergency Stop	SWT200
38	Timer – 120 Minute	TM20
39	Off-Gas Vent – Serviceable ¾ in X ½ in with ½ NPS Fitting	VAS7M
40	Solenoid Valve – 4 Way, Aluminum ¼ FPT, 12VDC	SV600
41	Plumbing Assembly – Drain	SUBAWP-10
42	Plumbing Assembly – Pump Inlet	SUBAWP-4
43	Plumbing Assembly – Pump Outlet	SUBAWP-5
44	Plumbing Assembly – Airplane Send Outlet	SUBAWP-7
45	Plumbing Assembly – Airplane Return Inlet	SUBAWP-8
46	Plumbing Assembly – Filter	SUBAWP-9
47	Oxygen Coalescing Filter Assembly	SUBAWP-13
48	Plumbing Assembly – Lower Water Separator	SUBAWP-11
49	Plumbing Assembly – Upper Water Separator	SUBAWP-12
50	Plumbing Assembly – Inlet	SUBAWP-2
51	Plumbing Assembly – Contact Tank Outlet	SUBAWP-6
52	Plumbing Assembly – Pump Return and Off-Gas	SUBAWP-3
53	Check Valve Assembly – Vacuum Relief, ¼ Compression Tee	CKVR250
54	Check Valve – 1in PVC Flapper Type, Clear	CKV85
55	Hose Hook	CWT1252
56	Transformer – Stepdown 120/240VAC to 24VAC	ELTR150
57	Switch – Cover Safety Interlock	SWT57
58	Plumbing Assembly – Venturi Injector	PFA202SA
59	Oxygen Control Board	CCA1818SA
60	HO Drive Board	CCA1231SA
61	Ozone Destruct	OCD105
62	Air Compressor Pressure Relief Valve	OXS362
63	Air Compressor Inlet Air Filter	OXS350


DRAIN INDICATOR
DRAIN BUTTON
OZONE INDICATOR
POWER INDICATOR
POWER SWITCH
ON
OFF
EMERGENCY
STOP
SUPPLY
CAUTION
RETURN
FILL
32
33
27
18
30
15
8
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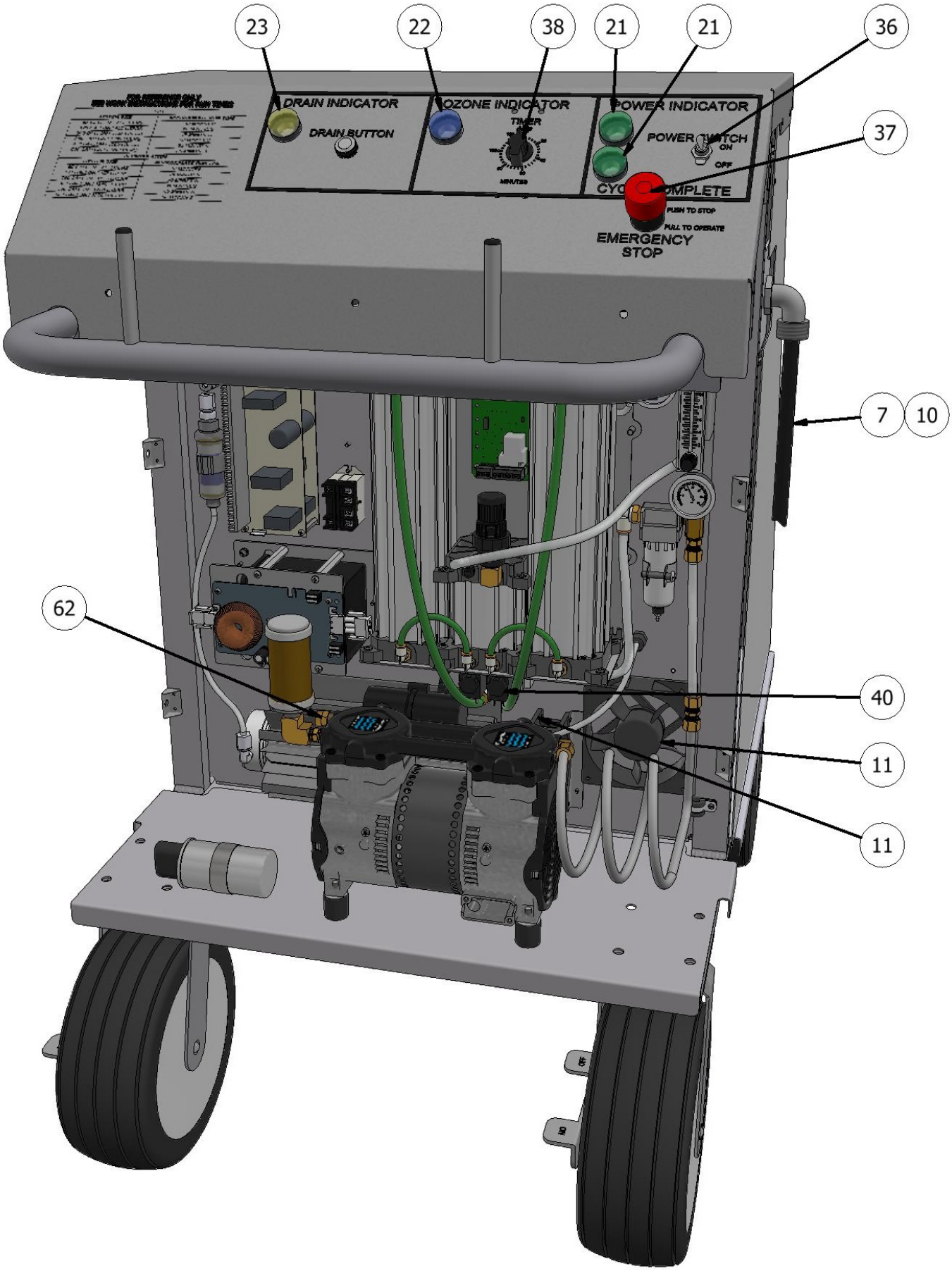
3
2
3


23
22
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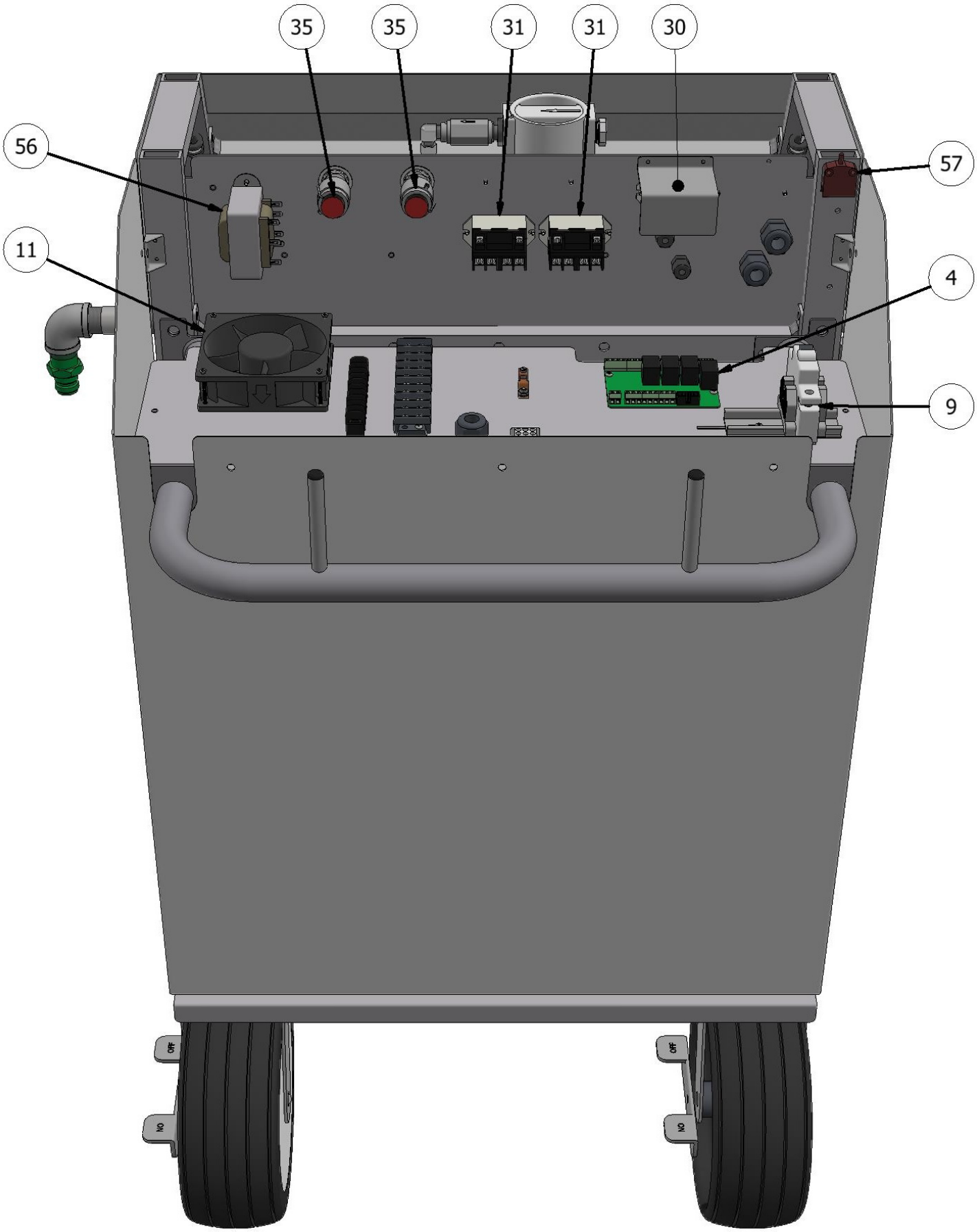
11
DRAIN INDICATOR
DRAIN BUTTON
OZONE INDICATOR
TIMER
POWER INDICATOR
POWER SWITCH
ON
OFF
PUSH TO STOP
PULL TO OPERATE
EMERGENCY
STOP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31
31
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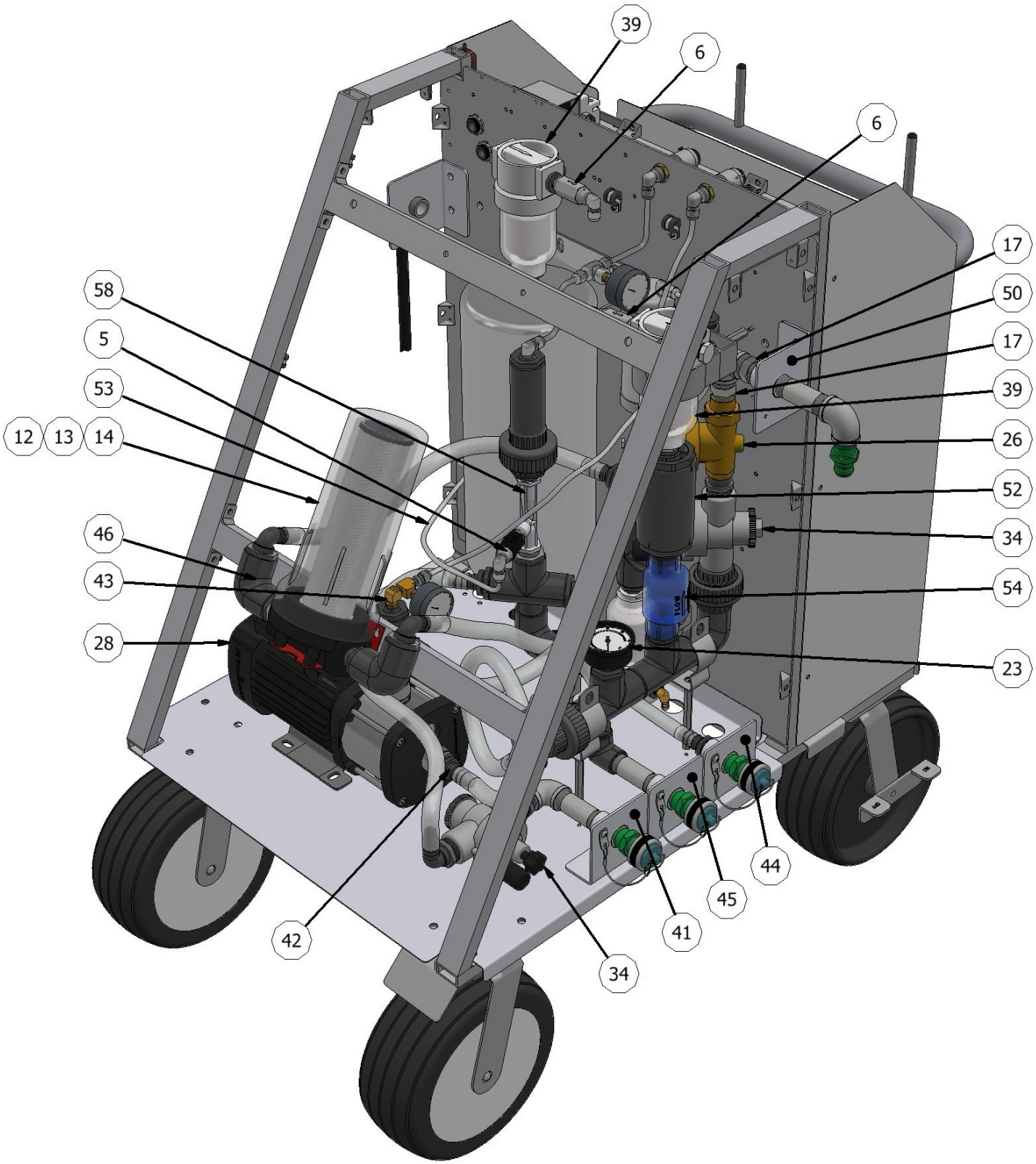
11
4
9
OFF
ON
OFF
ON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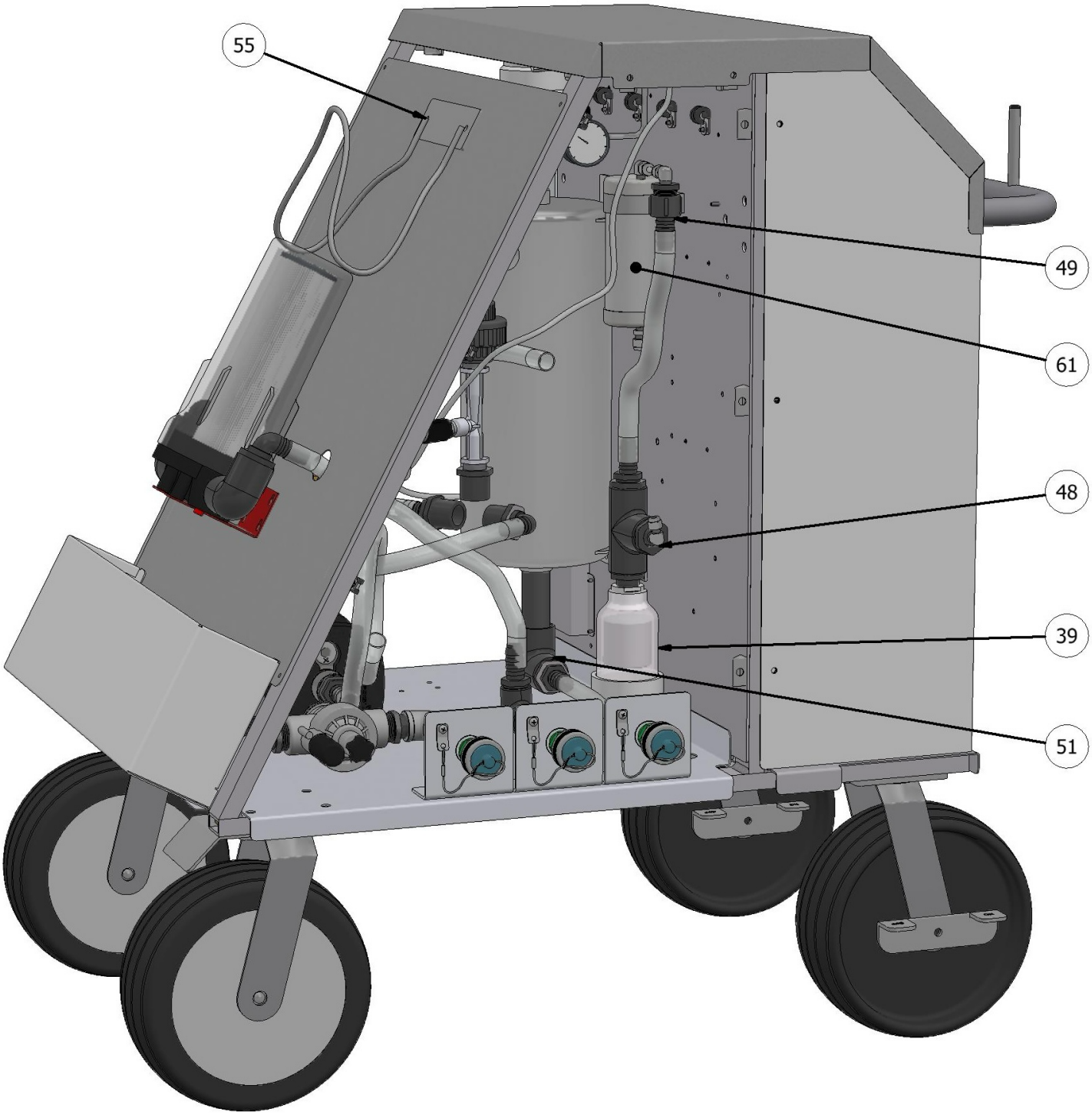
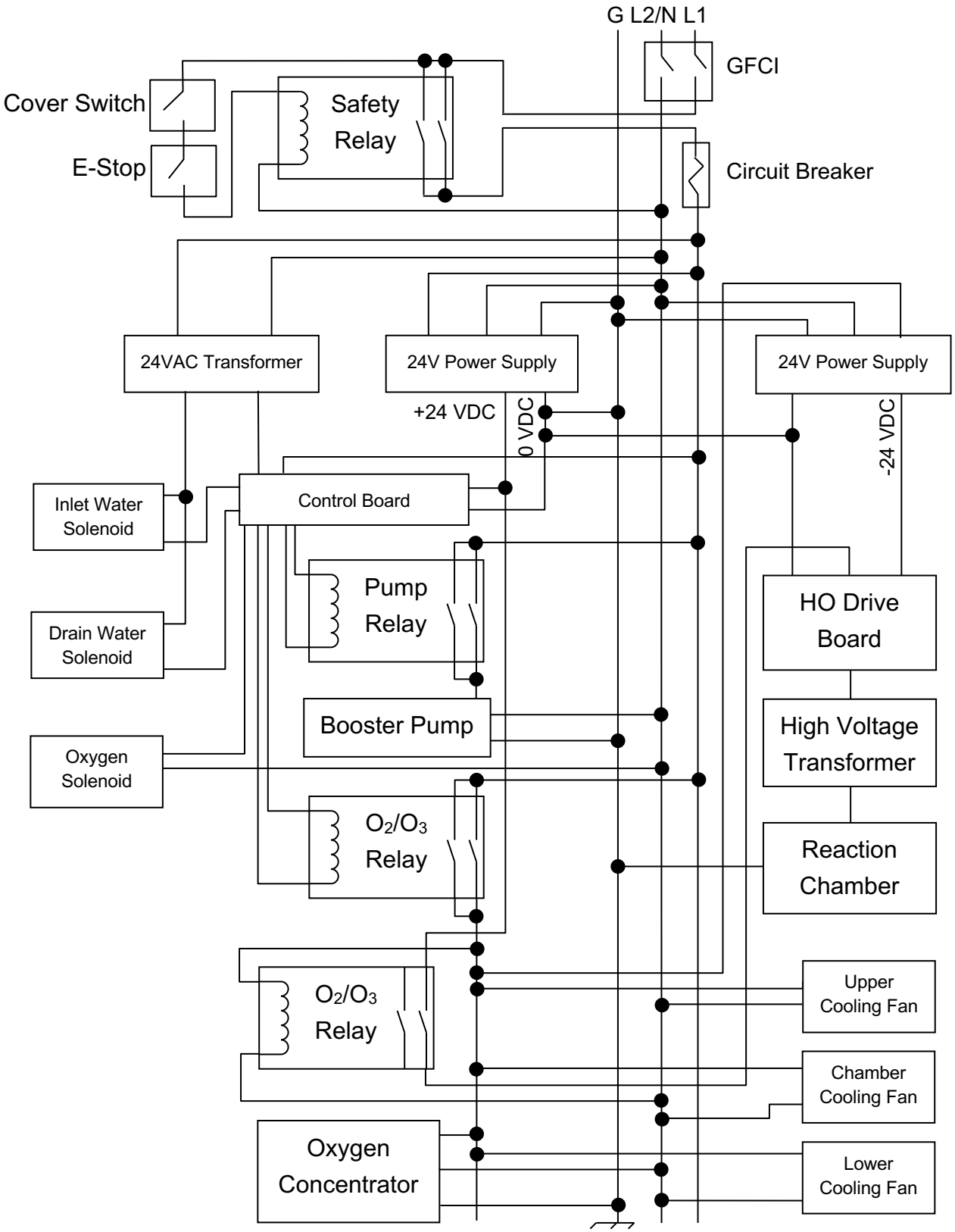

55
49
61
48
39
51

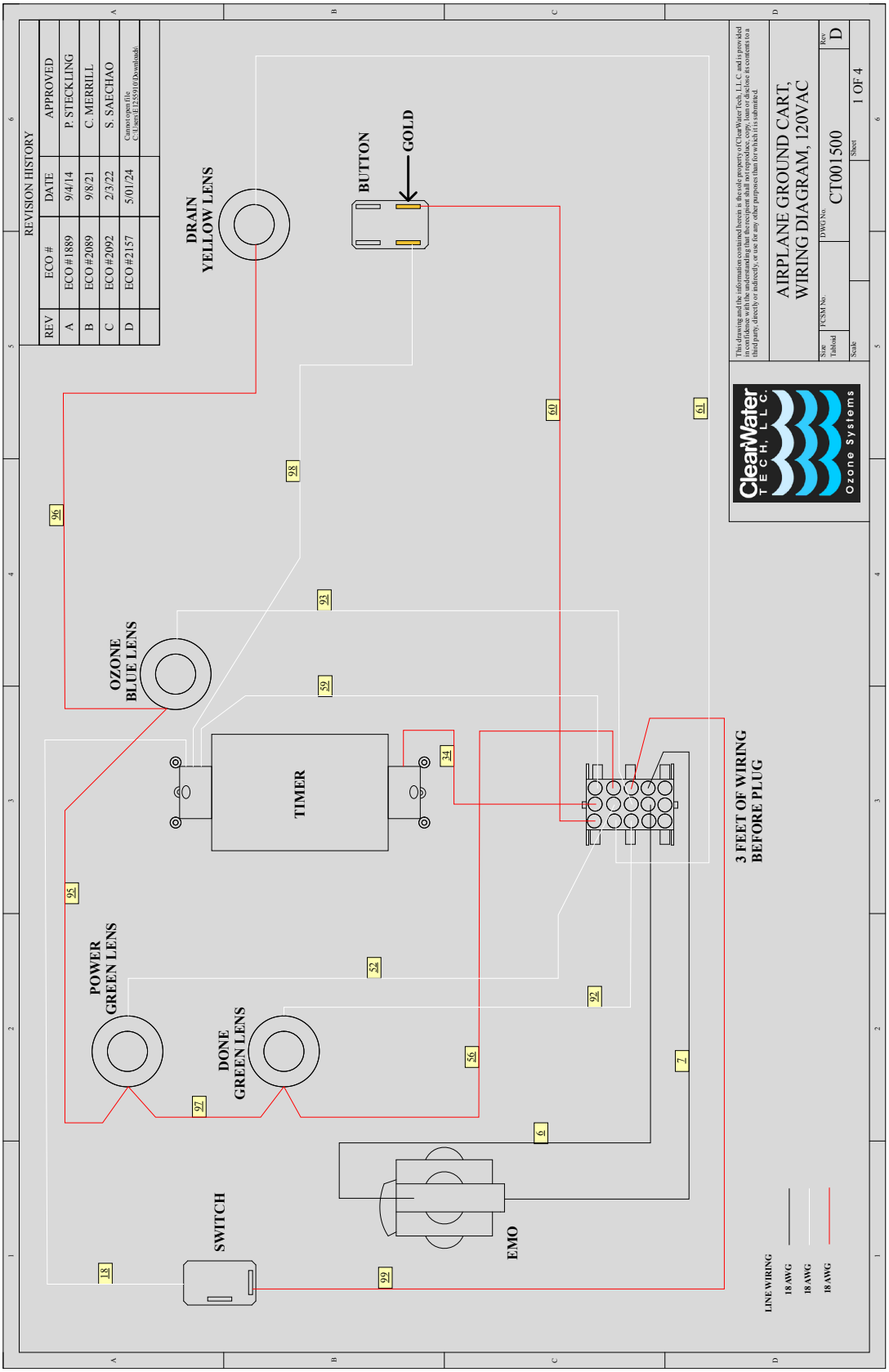
Appendix C – Hose Kits and Accessories

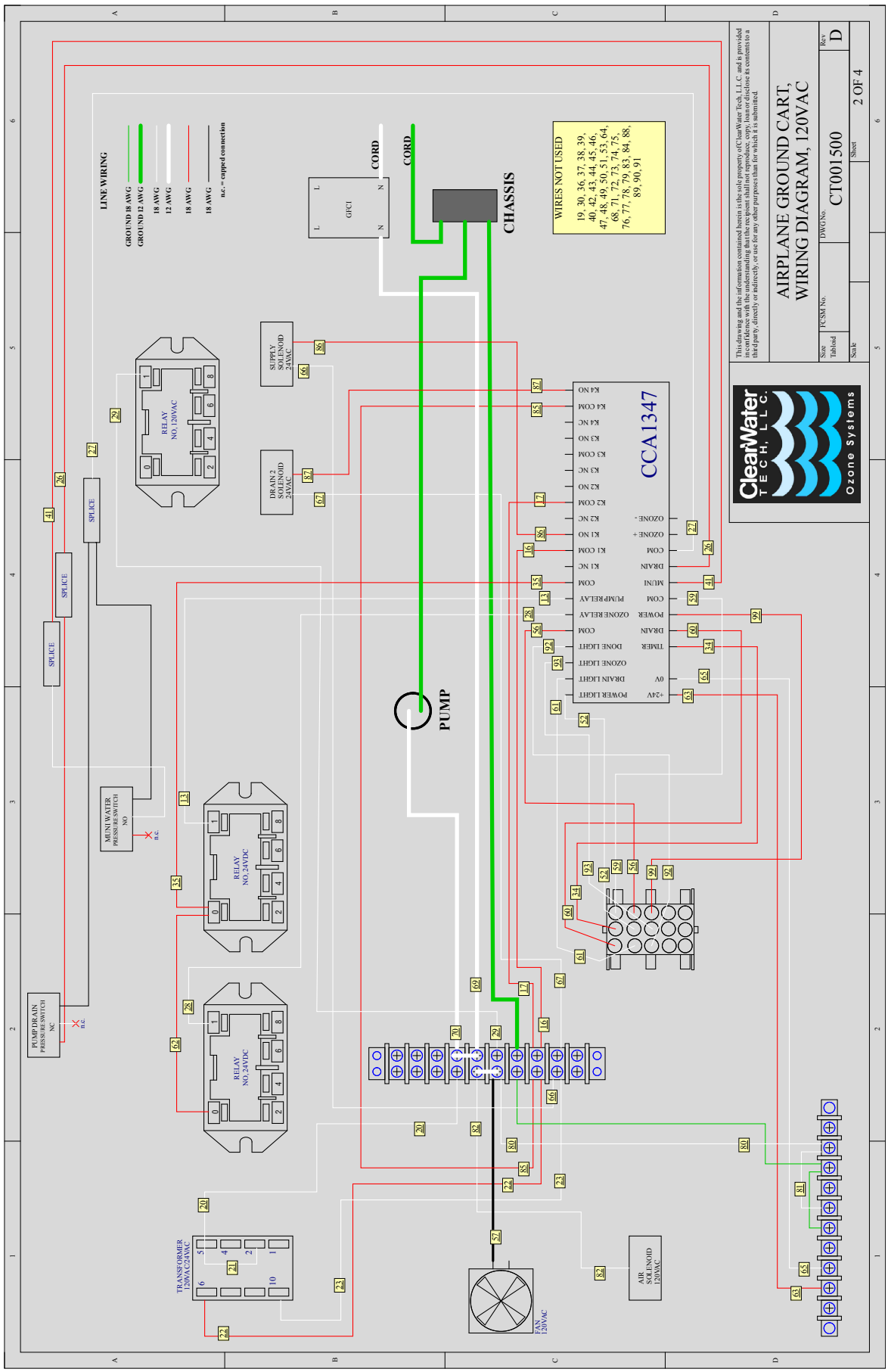
Part Number	Description
FTS424	Fitting – Waterfill Quick Connect Coupler, ¾ in
FTS466	Fitting – Waterfill Quick Connect Coupler, Long
FTS467	Fitting – Waterfill Quick Connect Plug
HA001	Hose Assembly – Drain
HA002	Hose Assembly – Return
HA003	Hose Assembly – Fill
HA005	Hose Assembly – Over Flow
HK005	Hose Kit – Universal For All Airplanes
TK21	CHEMetrics Aqueous Ozone Test Kit

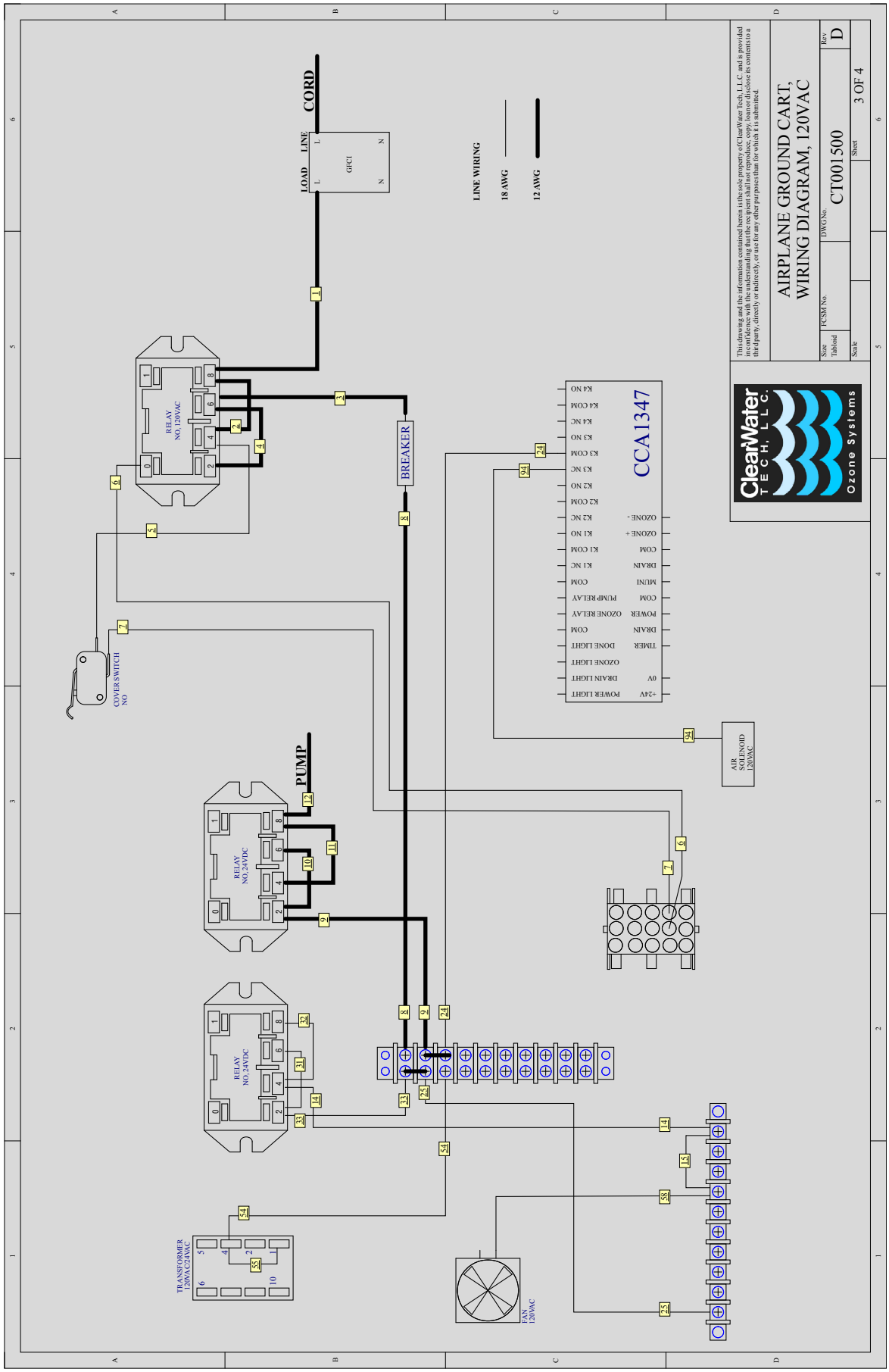
Appendix D – Logic Schematics

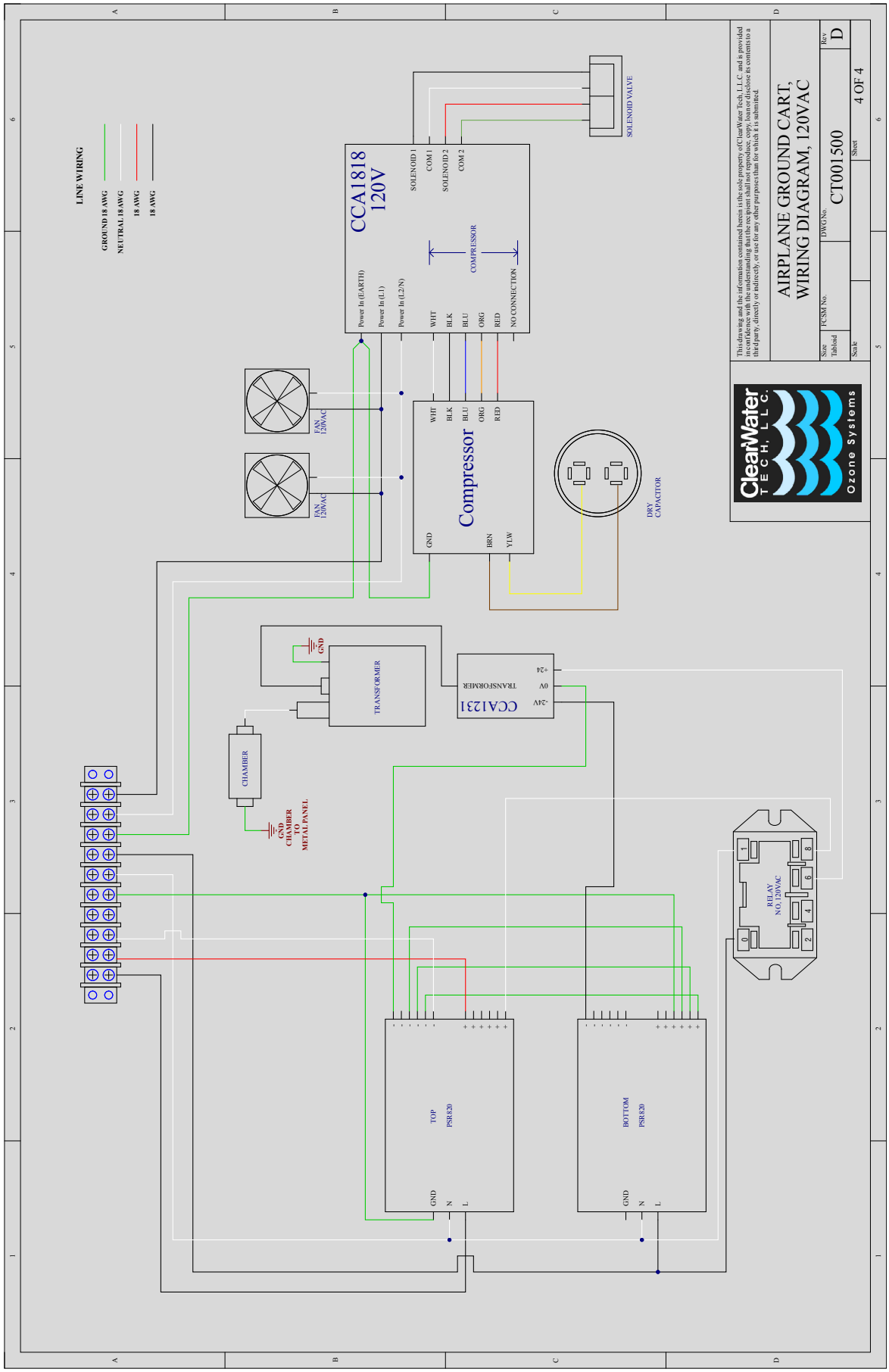


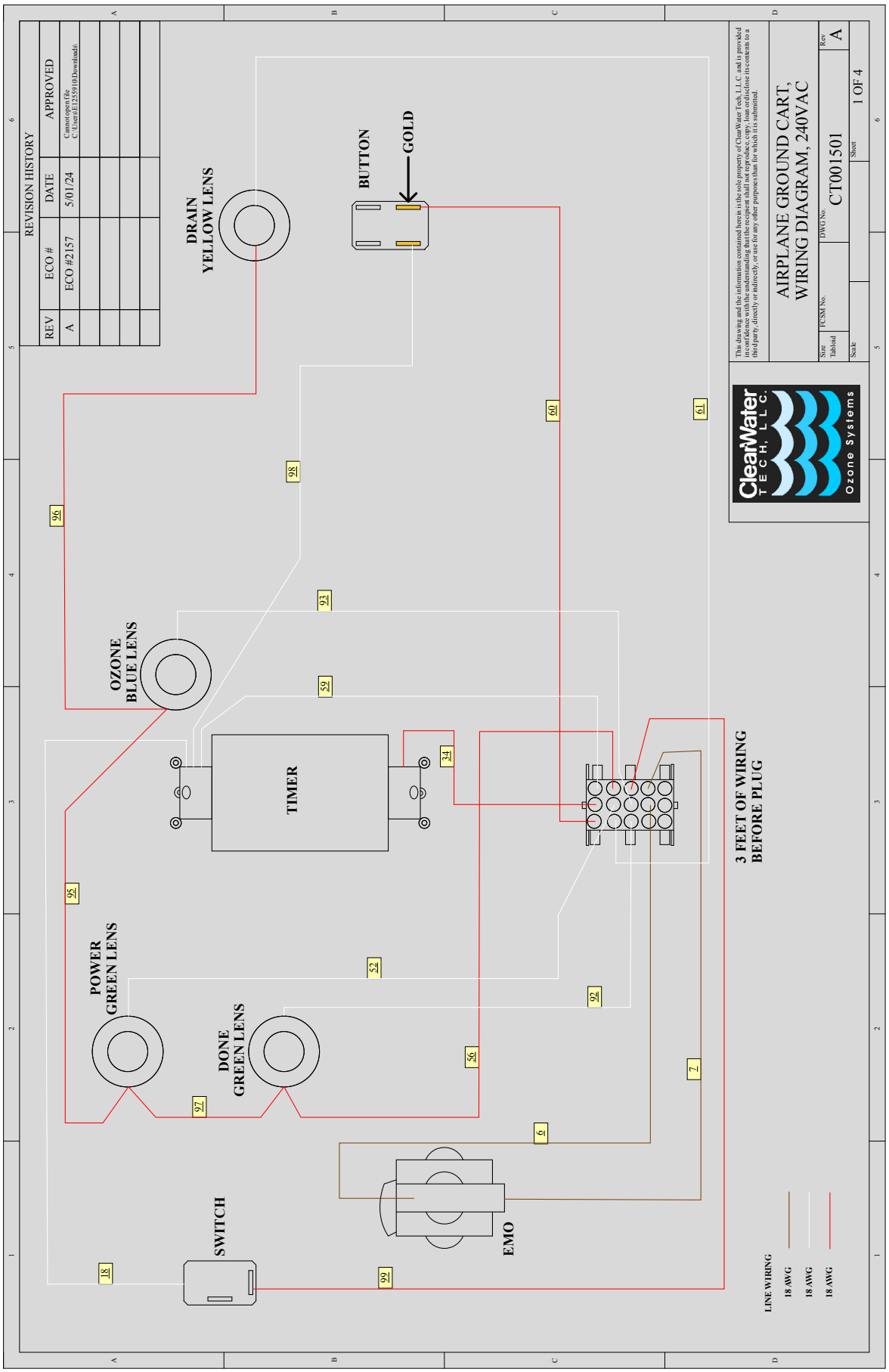
Appendix E – Electrical Schematics

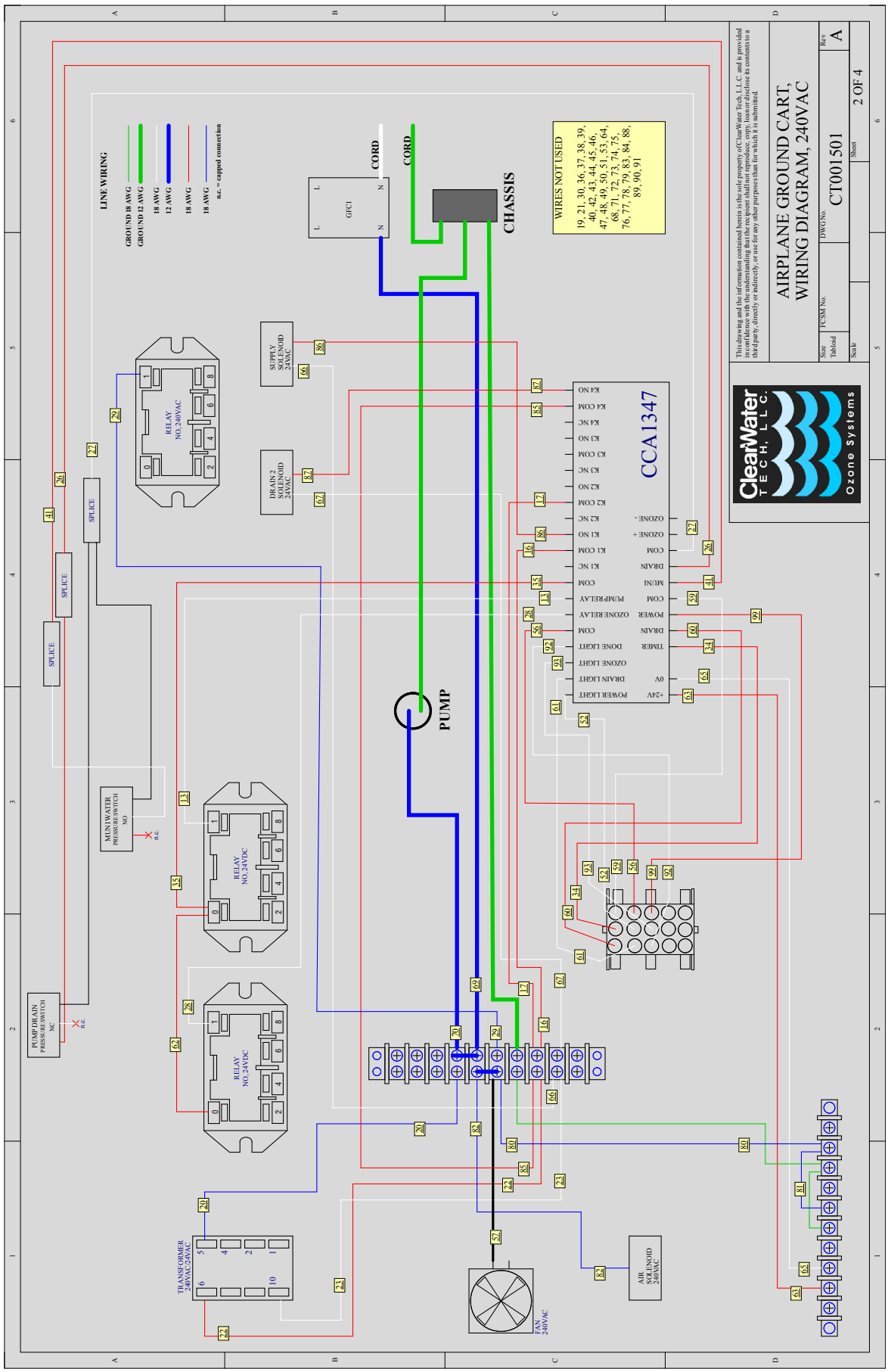


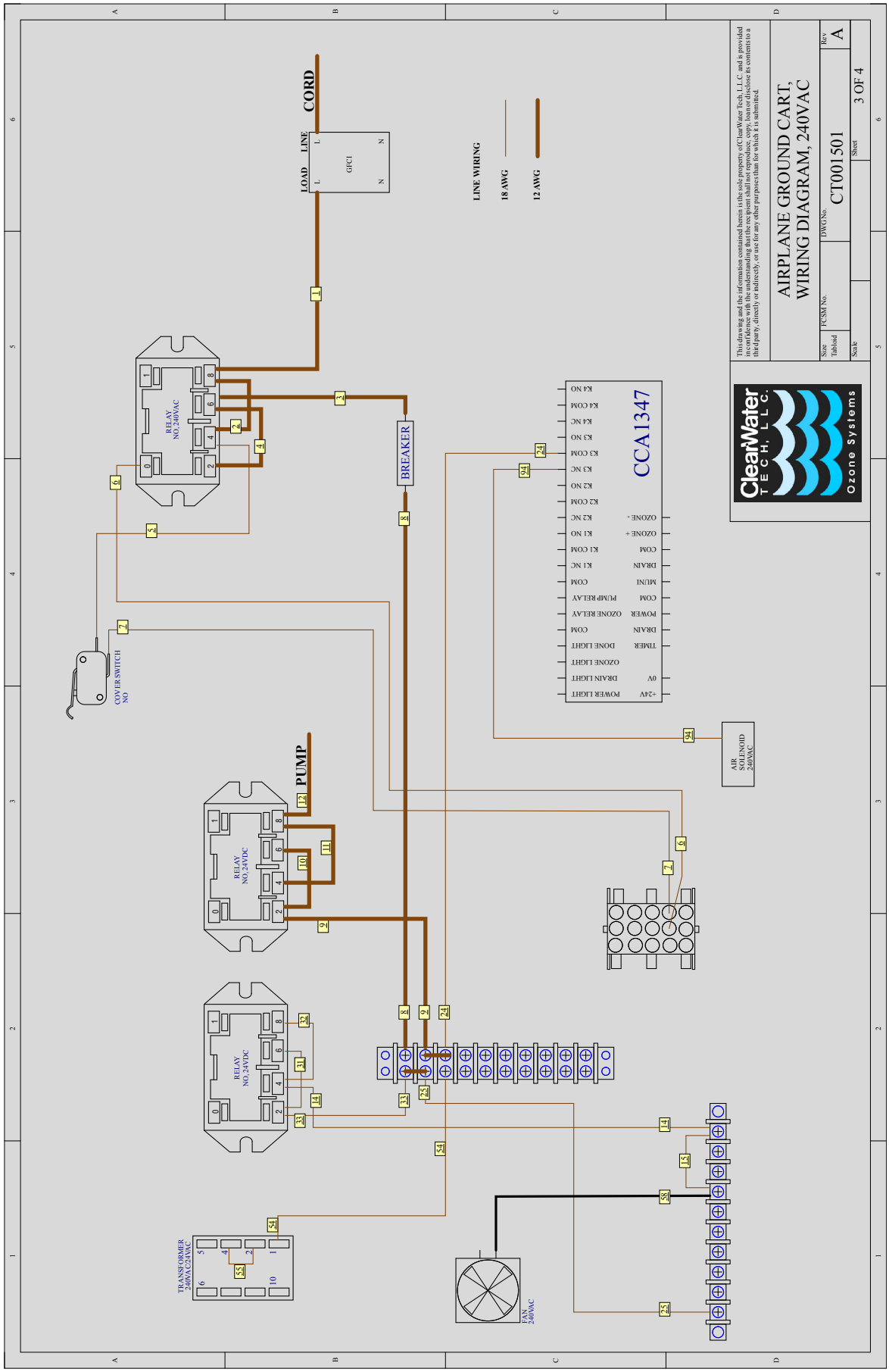

AIRPLANE GROUND CART,
WIRING DIAGRAM, 120VAC
CT001500
D
2 OF 4
ClearWater TECH, LLC.
Ozone Systems
CCA1347
LINE WIRING
GROUND 18 AWG
GROUND 12 AWG
18 AWG
12 AWG
18 AWG
18 AWG
n.c. = capped connection
WIRES NOT USED
19, 30, 36, 37, 38, 39, 40, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 53, 64, 68, 71, 72, 73, 74, 75, 76, 77, 78, 79, 83, 84, 88, 89, 90, 91
CHASSIS
CORD
CORD
GFCI
PUMP
SUPPLY SOLENOID 24VAC
DRAIN 2 SOLENOID 24VAC
RELAY NO, 120VAC
RELAY NO, 24VDC
RELAY NO, 24VDC
RELAY NO, 24VDC
SPLICE
SPLICE
SPLICE
MAIN WATER PRESSURE SWITCH NO
PUMP DRAIN PRESSURE SWITCH NC
TRANSFORMER 120VAC/24VAC
FAN 120VAC
AIR SOLENOID 120VAC
K4 NO
K4 COM
K4 NC
K3 NO
K3 COM
K3 NC
K2 NO
K2 COM
K2 NC
K1 NO
K1 COM
K1 NC
COM
PUMP RELAY
COM
OZONE RELAY
COM
DRAIN
TIMER
DONE LIGHT
OZONE LIGHT
DRAIN LIGHT
POWER LIGHT
OZONE -
OZONE +
COM
DRAIN
MAIN
COM
POWER
DRAIN
TIMER
0V
+24V

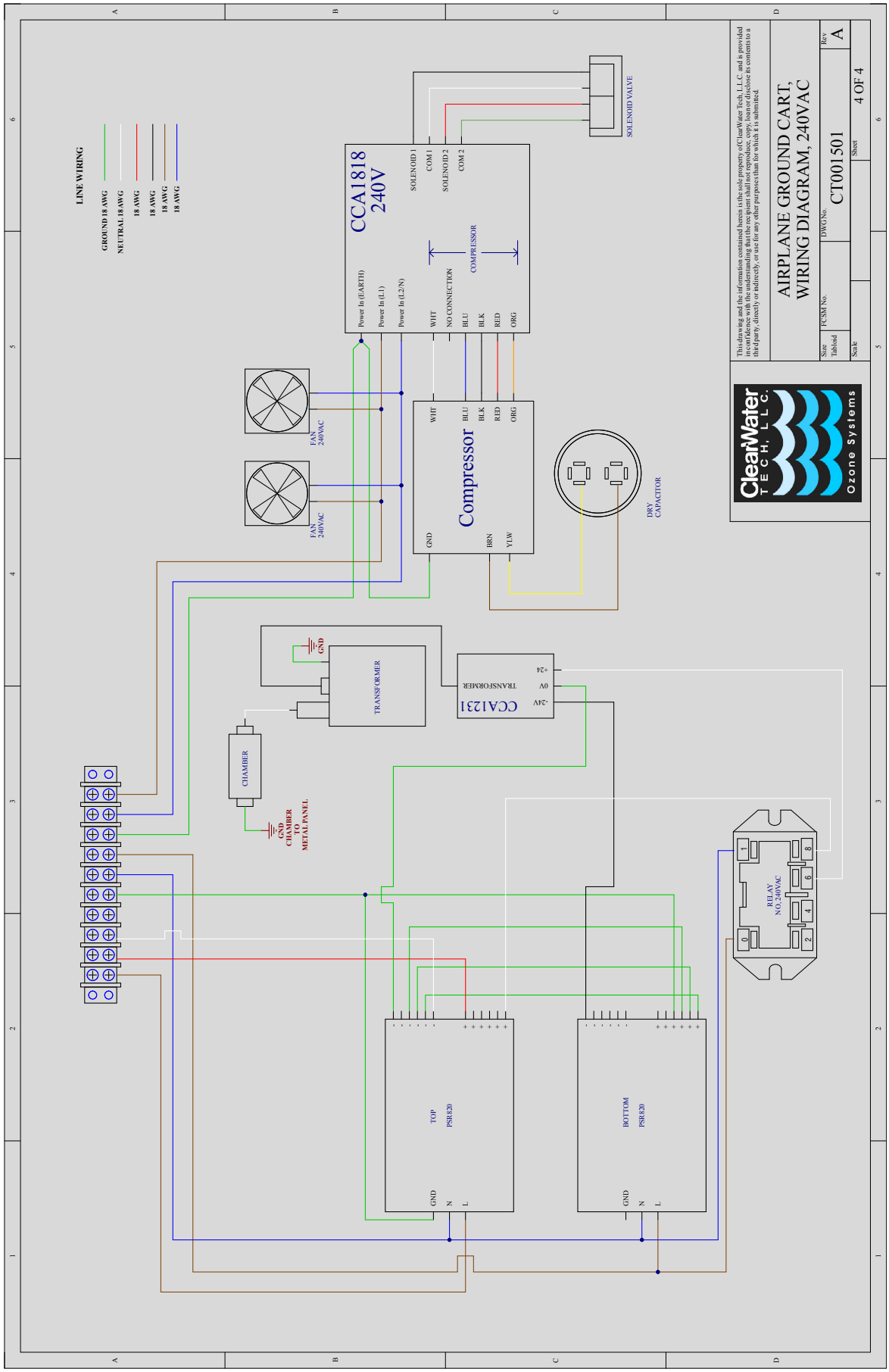

AIRPLANE GROUND CART,
WIRING DIAGRAM, 120VAC
DWG No. CT001500
Rev D
Sheet 3 OF 4
Size Tabloid
FCSM No.
Scale
ClearWater TECH, LLC.
Ozone Systems
This drawing and the information contained herein is the sole property of ClearWater Tech, L.L.C. and is provided in confidence with the understanding that the recipient shall not reproduce, copy, loan or disclose its contents to a third party, directly or indirectly, or use for any other purposes than for which it is submitted.
LINE WIRING
18 AWG
12 AWG
CORD
LOAD LINE
GFCI
BREAKER
RELAY NO, 120VAC
RELAY NO, 24VDC
PUMP
CCA1347
COVER SWITCH NO
AIR SOLENOID 120VAC
TRANSFORMER 120VAC/24VAC
FAN 120VAC


LINE WIRING
GROUND 18 AWG
NEUTRAL 18AWG
18 AWG
18 AWG
CCA1818
120V
Power In (EARTH)
Power In (L1)
Power In (L2/N)
SOLENOID 1
COM 1
SOLENOID 2
COM 2
COMPRESSOR
WHT
BLK
BLU
ORG
RED
NO CONNECTION
SOLENOID VALVE
Compressor
GND
BRN
YLW
FAN
120VAC
DRY
CAPACITOR
TRANSFORMER
CCA1231
TRANSFORMER
0V
-24V
+24
CHAMBER
GND
CHAMBER
TO
METAL PANEL
TOP
PSR820
BOTTOM
PSR820
RELAY
N.O. 120VAC
AIRPLANE GROUND CART,
WIRING DIAGRAM, 120VAC
DWG No.
CT001500
Rev
D
Sheet
4 OF 4
Size
Tabloid
Scale
FCSM No.
ClearWater
TECH, LLC.
Ozone Systems

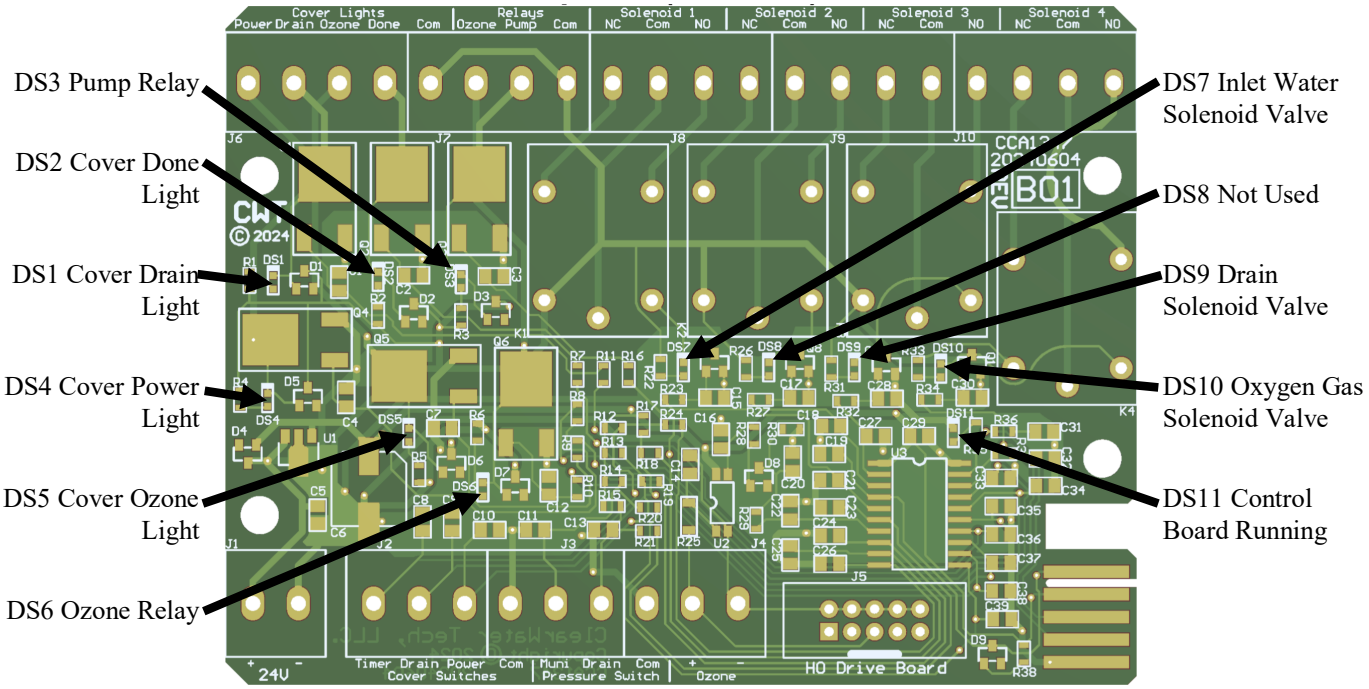

REVISION HISTORY
REV
ECO #
DATE
APPROVED
A
ECO #2157
5/01/24
DRAIN
YELLOW LENS
BUTTON
GOLD
OZONE
BLUE LENS
TIMER
POWER
GREEN LENS
DONE
GREEN LENS
SWITCH
EMO
3 FEET OF WIRING
BEFORE PLUG
LINE WIRING
18 AWG
18 AWG
18 AWG
AIRPLANE GROUND CART,
WIRING DIAGRAM, 240VAC
DWG No.
CT001501
Rev
A
Sheet
1 OF 4
ClearWater TECH, LLC.
Ozone Systems


AIRPLANE GROUND CART,
WIRING DIAGRAM, 240VAC
CT001501
A
2 OF 4
ClearWater TECH, LLC
Ozone Systems
CCA1347
LINE WIRING
GROUND 18 AWG
GROUND 12 AWG
18 AWG
12 AWG
18 AWG
18 AWG
n.c. = capped connection
WIRES NOT USED
19, 21, 30, 36, 37, 38, 39, 40, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 53, 64, 68, 71, 72, 73, 74, 75, 76, 77, 78, 79, 83, 84, 88, 89, 90, 91
CORD
CORD
GFCI
CHASSIS
PUMP
SUPPLY SOLENOID 24VAC
DRAIN 2 SOLENOID 24VAC
RELAY NO, 240VAC
RELAY NO, 24VDC
RELAY NO, 24VDC
RELAY NO, 24VDC
SPLICE
SPLICE
SPLICE
MUNI WATER PRESSURE SWITCH NO
PUMP DRAIN PRESSURE SWITCH NC
TRANSFORMER 240VAC/24VAC
FAN 240VAC
AIR SOLENOID 240VAC


AIRPLANE GROUND CART,
WIRING DIAGRAM, 240VAC
CT001501
3 OF 4
A
LINE WIRING
18 AWG
12 AWG
CORD
LOAD LINE
GFCI
BREAKER
CCA1347
RELAY NO,240VAC
RELAY NO,24VDC
PUMP
COVERSWITCH NO
AIR SOLENOID 240VAC
TRANSFORMER 240VAC/24VAC
FAN 240VAC
ClearWater TECH, LLC.
Ozone Systems


LINE WIRING
GROUND 18 AWG
NEUTRAL 18AWG
18 AWG
18 AWG
18 AWG
18 AWG
CCA1818
240V
Power In (EARTH)
Power In (L1)
Power In (L2/N)
SOLENOID 1
COM 1
SOLENOID 2
COM 2
NO CONNECTION
COMPRESSOR
WHT
BLU
BLK
RED
ORG
SOLENOID VALVE
Compressor
GND
BRN
YLW
FAN
240VAC
DRY
CAPACITOR
TRANSFORMER
CCA1231
TRANSFORMER
+24
0V
-24V
CHAMBER
GND
CHAMBER
TO
METAL PANEL
RELAY
N.O. 240VAC
TOP
PSR820
BOTTOM
PSR820
GND
N
L
This drawing and the information contained herein is the sole property of ClearWater Tech, L.L.C. and is provided in confidence with the understanding that the recipient shall not reproduce, copy, loan or disclose its contents to a third party, directly or indirectly, or use for any other purposes than for which it is submitted.
AIRPLANE GROUND CART,
WIRING DIAGRAM, 240VAC
Size
Tabloid
FCSM No.
DWG No.
CT001501
Rev
A
Sheet
4 OF 4
Scale
ClearWater
TECH, LLC.
Ozone Systems

Appendix F – Control Board LEDs



DS1 Cover Drain Light – This LED indicates that the control board is trying to turn on the "DRAIN" light on the cover. If the "DRAIN" light is not turning on, but this LED is "ON", the problem could be with the "DRAIN" light or the wiring connections.

DS2 Cover Done Light – This LED indicates that the control board is trying to turn on the "DONE" light on the cover. If the "DONE" light is not turning on, but this LED is "ON", the problem could be with the "DONE" light or the wiring connections.

DS3 Pump Relay – This LED indicates that the control board is trying to turn on the pump relay. If the pump relay is not turning on, but this LED is "ON", the problem could be with the pump relay or the wiring connections.

DS4 Cover Power Light – This LED indicates that the control board is trying to turn on the "POWER" light on the cover. If the "POWER" light is not turning on, but this LED is "ON", the problem could be with the "POWER" light or the wiring connections.

DS5 Cover Ozone Light – This LED indicates that the control board is trying to turn on the "OZONE" light on the cover. If the "OZONE" light is not turning on, but this LED is "ON", the problem could be with the "OZONE" light or the wiring connections.

DS6 Ozone Relay – This LED indicates that the control board is trying to turn on the ozone relay. If the ozone relay is not turning on, but this LED is "ON", the problem could be with the ozone relay or the wiring connections.

DS7 Inlet Water Solenoid Valve – This LED indicates that the control board is trying to turn on the inlet water solenoid valve. If the inlet water solenoid valve is not opening properly, but this LED is "ON", the problem could be with the inlet water solenoid valve or the wiring connections.

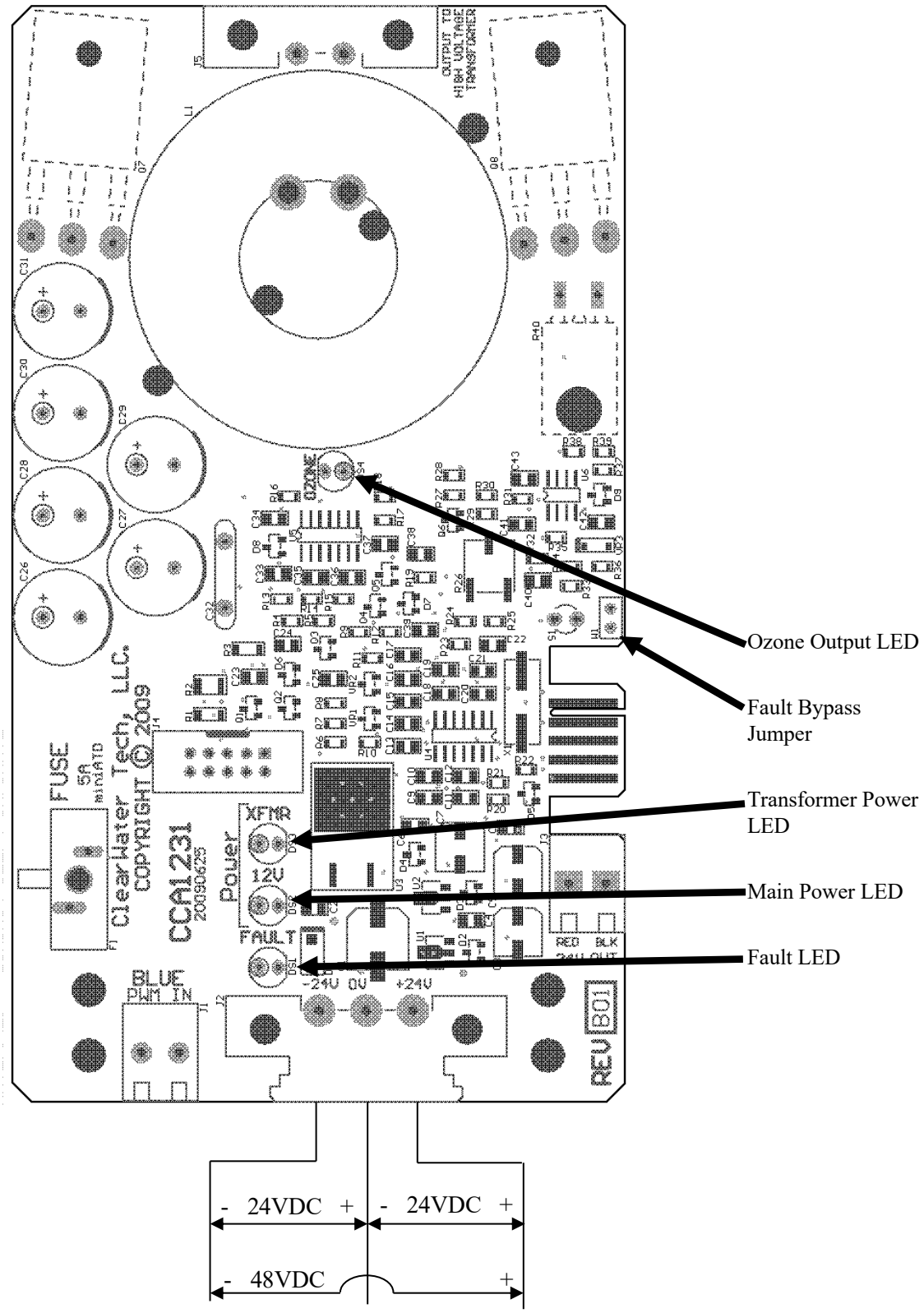
DS8 Not Used – Nothing is connected to this relay on the control board. This LED may still turn on and off, that is normal.

DS9 Drain Solenoid Valve – This LED indicates that the control board is trying to turn on the drain solenoid valve. If the drain solenoid valve is not opening properly, but this LED is "ON", the problem could be with the drain solenoid valve or the wiring connections.

DS10 Oxygen Gas Solenoid Valve – This LED indicates that the control board is trying to turn on the oxygen gas solenoid valve. If the oxygen gas solenoid valve is not opening properly, but this LED is "ON", the problem could be with the oxygen gas solenoid valve or the wiring connections.

DS11 Control Board Running – This LED blinks on an off as the program runs in the microcontrollers. The blinking lets the operator know the control board is powered and the microcontroller is operating correctly.

Appendix G – Drive Module Input Voltages and LEDs



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 to the drive transformer.

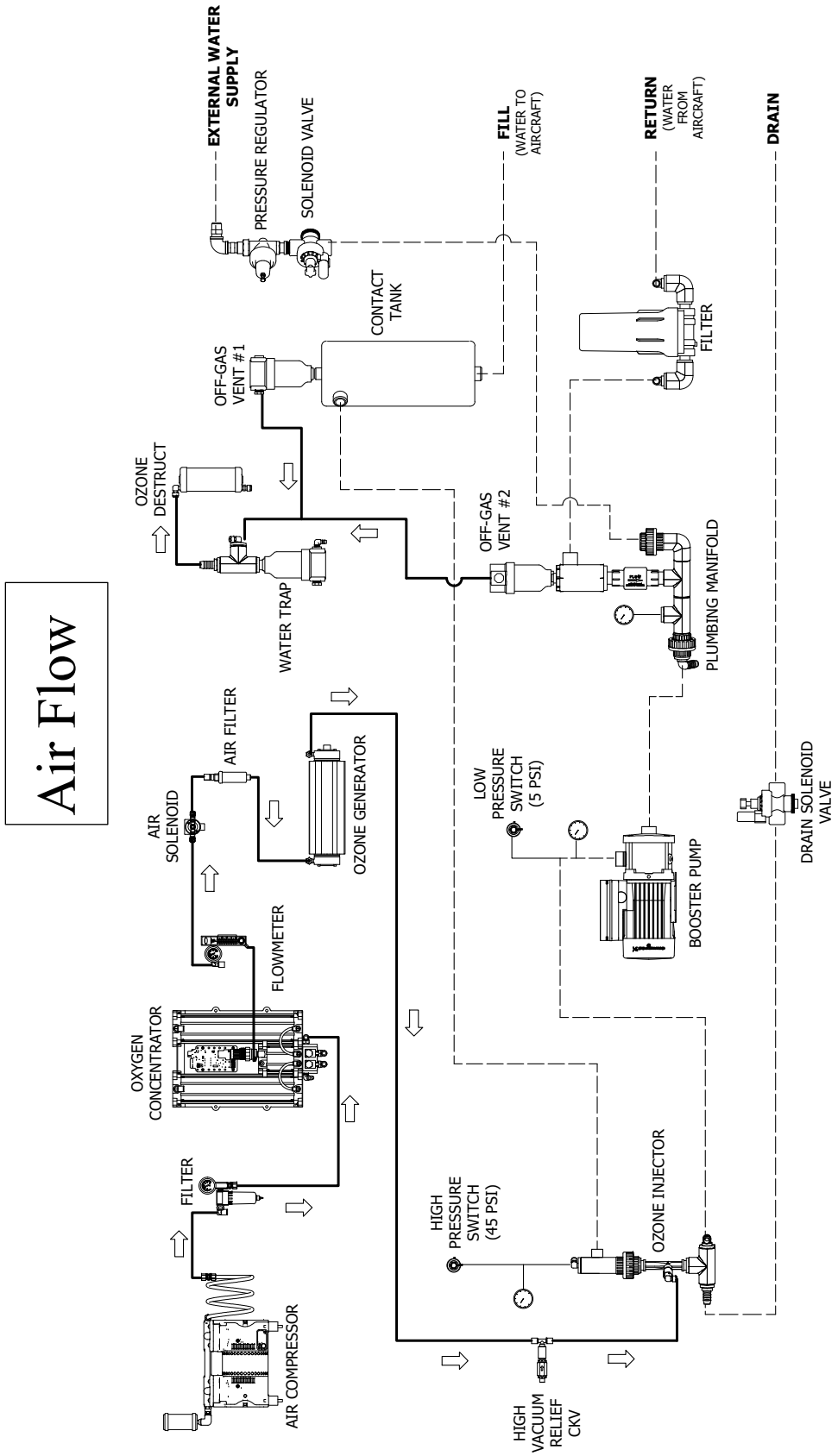
Ozone Output LED – The “Amber” ozone output LED will illuminate when ozone drive is sending power to the high voltage transformer.

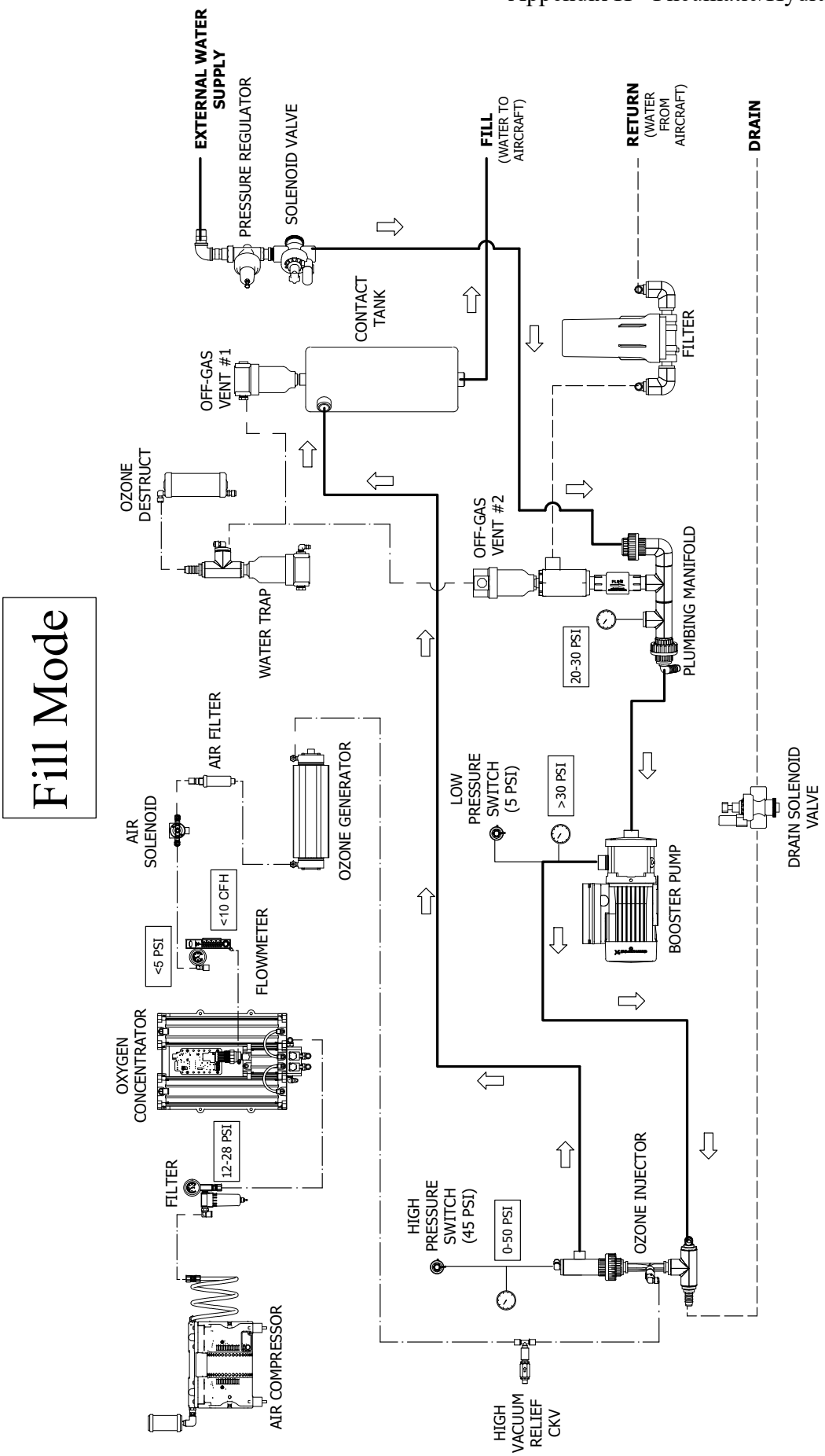
Fault LED – When illuminated, this “Red” LED indicates that there is a fault with the drive module or the Ozone Reaction Chamber. This LED will flash repeatedly while in fault mode.

Notes: If the drive module goes to a fault condition, the drive board will restart every 15 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.

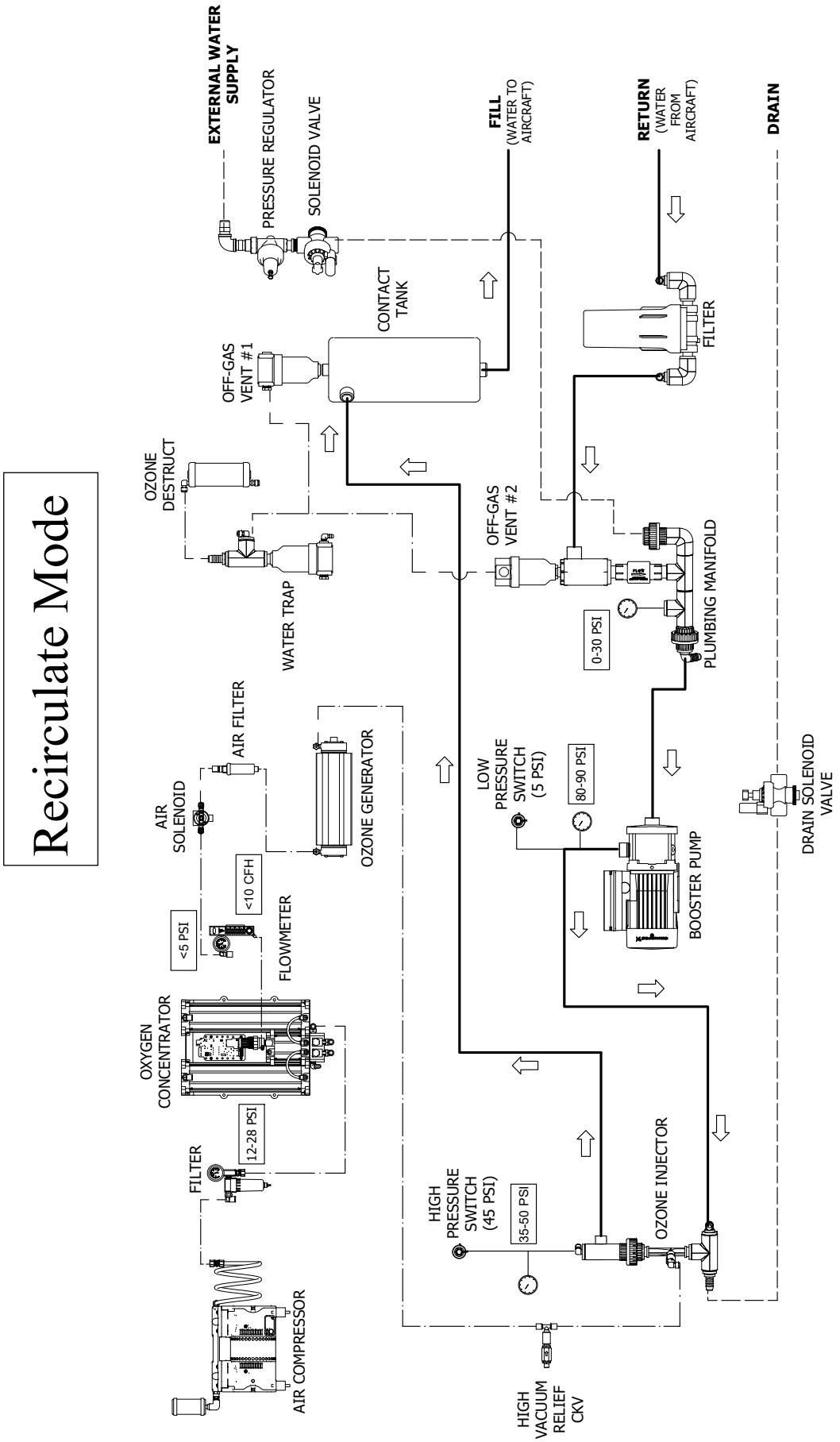
See Troubleshooting section for a more thorough description of the various fault modes.

Appendix H – Pneumatic/Hydraulic Schematic

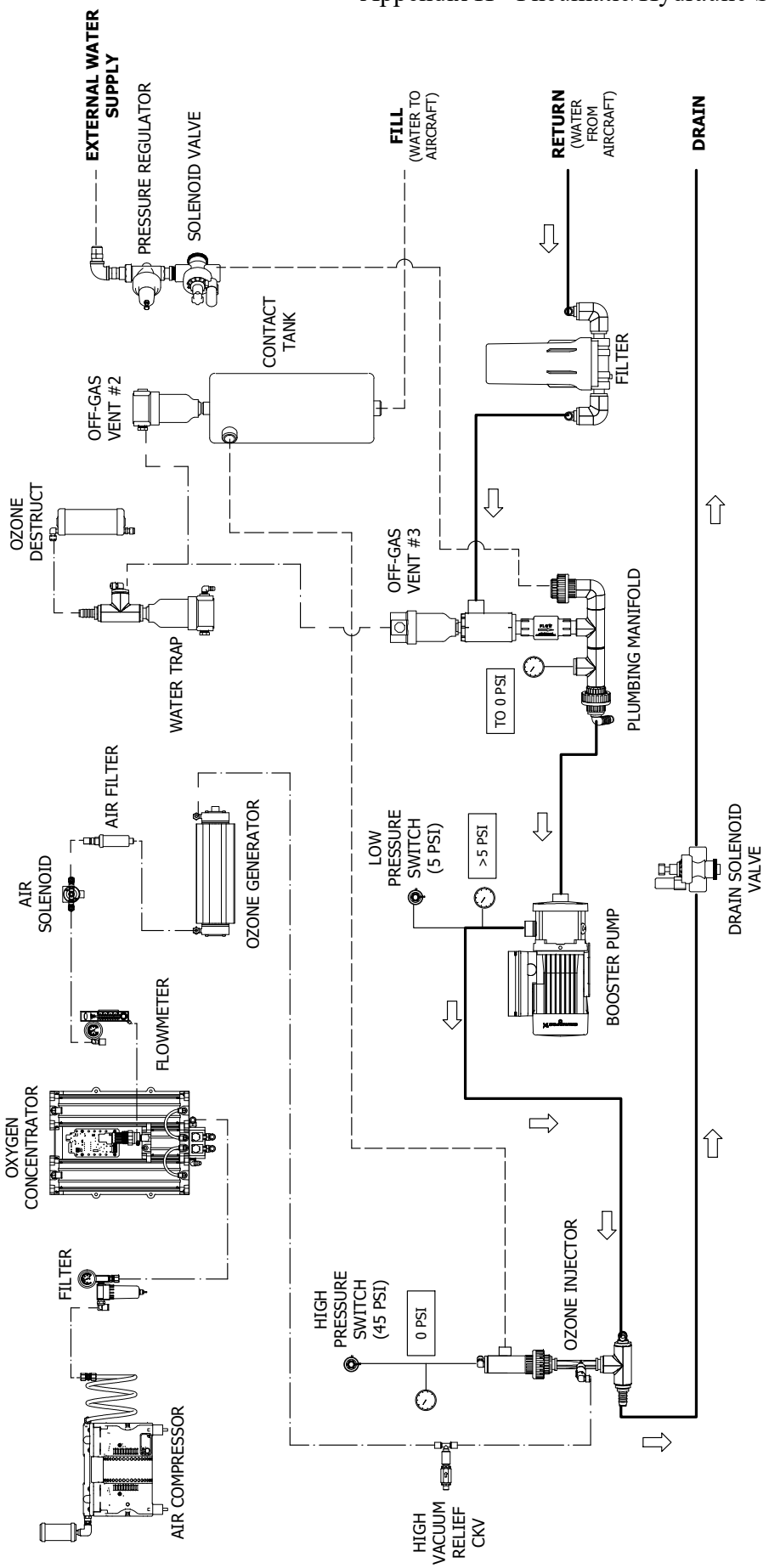



Fill Mode
EXTERNAL WATER SUPPLY
PRESSURE REGULATOR
SOLENOID VALVE
FILL (WATER TO AIRCRAFT)
RETURN (WATER FROM AIRCRAFT)
DRAIN
CONTACT TANK
FILTER
OFF-GAS VENT #1
OZONE DESTRUCT
WATER TRAP
OFF-GAS VENT #2
20-30 PSI
PLUMBING MANIFOLD
AIR FILTER
AIR SOLENOID
OZONE GENERATOR
LOW PRESSURE SWITCH (5 PSI)
>30 PSI
DRAIN SOLENOID VALVE
<10 CFH
<5 PSI
FLOWMETER
BOOSTER PUMP
OXYGEN CONCENTRATOR
12-28 PSI
FILTER
HIGH PRESSURE SWITCH (45 PSI)
0-50 PSI
OZONE INJECTOR
AIR COMPRESSOR
HIGH VACUUM RELIEF CKV

Recirculate Mode



Drain Mode


EXTERNAL WATER SUPPLY
PRESSURE REGULATOR
SOLENOID VALVE
FILL (WATER TO AIRCRAFT)
RETURN (WATER FROM AIRCRAFT)
DRAIN
CONTACT TANK
FILTER
OFF-GAS VENT #2
OZONE DESTRUCT
OFF-GAS VENT #3
WATER TRAP
TO 0 PSI
PLUMBING MANIFOLD
AIR FILTER
AIR SOLENOID
OZONE GENERATOR
LOW PRESSURE SWITCH (5 PSI)
>5 PSI
DRAIN SOLENOID VALVE
BOOSTER PUMP
FLOWMETER
OXYGEN CONCENTRATOR
FILTER
HIGH PRESSURE SWITCH (45 PSI)
0 PSI
OZONE INJECTOR
AIR COMPRESSOR
HIGH VACUUM RELIEF CKV

Appendix I – Material Safety Data Sheet

Product Name: Ozone	This MSDS complies with OSHA's Hazard Communication Standard, 29 CFR 1910 1200 and OSHA form 174			
Section I				
Manufacturer's name: ClearWater Tech	Emergency Telephone Number: (805) 546-2333			
Address: 850 Capitolio Way	Telephone Number for Information: (805) 549-9724			
San Luis Obispo, CA 93401	Date Prepared: 7/2/2013			
Section II—Hazardous Ingredients/Identity Information				
Hazardous Components:	OSHA PEL	ACGIH TLV	Other Limits	%
Ozone	0.1 PPM	0.1 PPM	NIOSH 0.1 PPM	NA
Section III—Physical/Chemical Characteristics				
Boiling Point:	-169 F	Specific Gravity:	NA	
Vapor Pressure (mm Hg):	760	Freezing Point:	NA	
Vapor Density (AIR = 1):	1.6	Evaporation Rate:	N/A	
Solubility in Water:	570 mg/l @ 20 C			
Appearance and Odor: Clear at low concentrations, blue at higher concentrations. Aseptic odor.				
Section IV—Fire and Explosion Hazard Data				
Flash Point: N/A	Flammable Limits:	LEL: NA	UEL: N/A	
Extinguishing Media: Use extinguishing agents suitable for surrounding fire				
Special Fire Fighting Procedures: Wear self-contained breathing apparatus				
Unusual Fire and Explosion Hazards: Container may explode in heat of fire.				
Section V—Reactivity Data				
Stability	Unstable	X	Conditions to Avoid: None Known	
	Stable			
Incompatibility: Natural rubber may degrade over extended periods of exposure				
Hazardous Decomposition or Byproducts: None				
Hazardous Polymerization:	May Occur		Conditions to Avoid: None Known	
	Will Not Occur	X		

Section VI—Health Hazard Data					
Route(s) of Entry	Inhalation X	Skin X	Ingestion No	Eye X	Hazardous No
Health Hazards					
Acute: Mild skin, eye, nose, throat, respiratory tract irritation					
Chronic: May cause breathing disorders.					
Carcinogenicity: No	NTP: No	IARC Monographs: No	OSHA Regulated: No		
Signs and Symptoms of Exposure:					
Mild eye or lung irritation if exposed for extended periods of time. Drying or mild irritation of the skin if exposed for extended periods of time.					
Medical Conditions Generally Aggravated by Exposure: Chronic Pulmonary Problems					
Emergency and First Aid Procedures: Get fresh air, flush eyes with water					
Section VII—Precautions for Safe Handling and Use					
Steps to Be Taken in Case Material Is Released or Spilled: Ventilate area					
Waste Disposal Method: Treat with Ozone destruct unit before releasing into atmosphere					
Precautions to Be Taken in Handling and Storing: None					
Other Precautions: N/A					
Section VII—Control Measures					
Respiratory Protection: Not required for normal use					
Ventilation:	Local: Exhaust		Special N/A		
	General: Exhaust		Other N/A		
Protective Gloves: Not required	Eye Protection: Not required				
Other Protective Clothing or Equipment: Not required					
Work/Hygienic Practices: N/A					

This material safety data sheet is provided as an information resource only. It should not be taken as a warranty or representation for which the preparer assumes legal responsibility. While we believe the information contained herein is accurate and compiled from sources believed to be reliable, it is the responsibility of the user to investigate and verify its validity. The buyer assumes all responsibility of using and handling the product in accordance with applicable federal, state, and local regulations.

Appendix J – Warranty Information

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

Warranty Validation and Registration

Scan to Register Product Online

To validate the warranty, the product must be registered either by; filling out the warranty card provided and returning it to CWT by mail or registering the product on-line at **warranty.cwtozone.com**. Scanning the QR Code, with a mobile device, will link directly to the Product Warranty Registration form located on the CWT website.

To obtain validation of the 3-year limited warranty; the CWT product(s) must be installed and operated within usage parameters stated, and service intervals performed as specified in the product(s) I/O manual. Failure to do so will void warranty.

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 I/O manual
- Oxygen systems and Ozone sensors have a one (1) year warranty
- 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
- Service or maintenance parts outlined within the I/O manual
- Equipment not manufactured by CWT will carry the OEM's factory warranty

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.