



Ozone Generator System

May 2020

OPERATION AND MAINTENANCE MANUAL Manual WO-5984

Prepared for:

Prepared by:

Product Recovery Management
200 20th Street
Butner, North Carolina 27509
(919) 957-8890

TABLE OF CONTENTS

1.0	System Overview	3
2.0	Design Specifications	5
3.0	System Operation	6
3.1	Startup	6
3.2	Control Logic	9
3.3	HMI Control Screens	10
4.0	Maintenance	14
5.0	Troubleshooting	17

FIGURES

- Figure 1: System Layout
- Figure 2: Control Schematic
- Figure 3: Wiring Diagram
- Figure 4: P&ID

APPENDICES

- Appendix A: General Equipment Manuals - Digital Version

*The digital version of the manual can be located on the PRM Flash Drive or by scanning the QR Code.



1.0 SYSTEM OVERVIEW

Product Recovery Management, Inc. (PRM) has supplied a SpartOx Ozone Generator System designed for use in your application.

Ozone systems have inherent potential hazards which need to be addressed on a case by case basis. It is the Client's responsibility to know and assess any associated hazard. As an example, your system may have been designed for a Class 1 Division 2 Hazardous Location. It is the Client's responsibility to confirm that the hazardous location is addressed properly. In the event that a system is used in a location where site conditions and hazards have changed, it is the Client's responsibility to assess the new conditions and evaluate the remediation system properly. The Client needs to contact PRM ASAP if any operation/design discrepancies arise due to changing conditions.

A licensed electrical contractor must be used to connect power to the system. Please tell the electrical contractor to contact PRM corporate office (919)-957-8890 with any questions about connecting power to the system. Failure to use a licensed electrician will void the warranty.

If a high leg exists make sure that it is connected to the center phase (L2) of the distribution block in the panel.

Field wiring interconnections are not to cross the intrinsically safe zone of the panel because intrinsic safety may be impaired.

Hearing protection should be worn at all times when equipment is operating. Permanent hearing damage may occur if proper protection is not worn.

PRM is pleased to have provided our client with this Ozone Generator Panel.

When the system is activated, the solenoid will allow the supplied oxygen to flow through the Ozone Generator to purge the system for 5 minutes. After the purge the PTI 10G Ozone Generator will begin using the oxygen to generate Ozone. The needle valve on the right side of the panel is used to adjust the flow of the gas. Optimal flow rate is 4slmp. An additional ball valve has been provided to be used to connect to an optional gas analyzer.



Work and safety guidelines should be established by the client to ensure the wellbeing of the workers and any others who may be exposed to ambient contaminants. The following OSHA and NIOSH information should help when determining safety guidelines:



OSHA guidelines for Ozone in the workplace are based on time-weighted averages. Ozone levels should never exceed the following average: 0.10 ppm (parts per million) for 8 hours per day exposure.

For more detailed information on safe ozone levels, see the bullet points below.

The OSHA website cites several ACGIH (American Conference of Governmental Industrial Hygienists) guidelines for ozone in the workplace:

- 0.2 ppm for no more than 2 hours exposure
- 0.1 ppm for 8 hours per day exposure doing light work
- 0.08 ppm for 8 hours per day exposure doing moderate work
- 0.05 ppm for 8 hours per day exposure doing heavy work

For more information, see the OSHA webpage regarding ozone:

http://www.osha.gov/dts/chemicalsampling/data/CH_259300.html



Unlike OSHA, [NIOSH](#) safety and health standards are not enforceable under US law. However, NIOSH does "develop recommendations for health and safety standards" that may influence future law and OSHA regulations.

The NIOSH recommended exposure limit for ozone is 0.1 ppm (0.2 mg/m³). According to NIOSH, Ozone levels of 5 ppm or higher are considered immediately dangerous to life or health.

2.0 DESIGN SPECIFICATIONS

PRM has provided a fully packaged Ozone Injection System for your project in accordance with the design specifications. The equipment is itemized in the written proposal below

SPARTOX Ozone Generator Panel

- UL listed in Nema 4/12 Enclosure.
- 10G/hr PTI Gen 2 Solid State Ozone Generator
- Fan Cooled Ventilation with mounted inlet vent
- Siemens LOGO! PLC system with
 - Weintek Color HMI
- Sierra Mass Flowmeter

3.0 SYSTEM OPERATION

A SYSTEM OPERATION plan should be developed for the ozone generator system that ensures proper operation of the treatment system. This plan should be developed based on actual site conditions such as overall air/water flow rate. During the first two weeks of operation, daily inspections should be made of the system. Components should be adjusted for maximum system efficiency.

3.1 STARTUP

The following items should be completed before energizing the main power.

For All Systems:

1. Level the equipment. If in a trailer or building, check door openings to see if additional leveling is necessary.
2. Tighten all terminals where wires are terminated. Electrical components may work loose during shipping.
3. Remove IS barriers from bases if present.
4. Check to ensure that both the hazardous and non-hazardous sides of the IS barriers are properly grounded directly to the main ground or to a grounding stake as per the codes of the local authorities.
5. Before the system is energized, check your voltage to ground on each leg for high voltage. If voltage above 215 from phase to ground is detected then damage to the system will occur.
6. If you have a PLC, check to ensure the PLC is in "auto" mode.
7. Test each input going into the Hazardous side of the IS barrier for proper IS barrier locations. This can be done by using an electrical multi-meter and check for continuity to ground. Have one person hold the meter while another person manually operates the switch or float. Ensure that the switches are field wired as normally closed or normally open as specified on the electrical drawings.
8. Check the voltage on each phase of power to ground. The voltage on each leg should be the same or close to the same. If one phase is higher, the "high leg" should be on the center lug.
9. Check to ensure there is only one source of neutral. If there is a 120 volt control transformer in the panel then we ground the neutral and no neutral should be brought into the panel.
10. Check to ensure the panel is properly grounded and there is only one main source of ground.

Ensure all necessary electrical approvals are in place before proceeding. Energize after all the items listed above have been completed.

The following can be completed once the system is energized and should be done after all the items listed above have been completed.

1. Check the power on the hot side of the main fuses.
2. Install fuses to the AC transformer if present and check the power on the primary and secondary sides of the AC transformer.
3. Install fuses to the DC transformer if present and check the power to the primary and secondary sides of the DC transformer.
4. Close the remaining fuse holders and check for power on the bottom of each fuse holder to ensure the fuses are good. If a fuse is blown then there may be a short somewhere. Check for resistance between the bottom of that fuse holder and the ground. If there is a short then there will be little resistance. Less than 0-1 Ohms. if a short is detected, follow the line out of the bottom of the fuse holder and continue to check for lack of resistance until you locate the short.
5. If there is power to the bottom of all the fuses, you can start testing the inputs. Check for voltage to the non-hazardous side of the IS barriers. There should be either 24V or 5V here depending on which type of PLC you are using or if you are using relay logic. If you have any other voltage, the IS barriers should not be installed because they could become damaged by the higher voltage. Find the source of the stray voltage and repair the problem. Install the IS barriers only when proper voltage is detected.
6. Test the inputs a second time. This time check to ensure that the correct input light on the PLC is turned on or the correct relay is activated. Check the input wiring diagram to ensure that the correct input is going to the correct IS barrier terminal on the hazardous side.
7. Test all shut-down alarms to ensure they are operating properly.
8. Install the fuses for motors and bump the motors to check for proper rotation. To reverse rotation switch two of the power legs. Refer to the wiring diagram on the motor. If a single phase motor is rotating in the wrong direction, then check for proper wiring.
9. Always refer to the specified documentation for each piece of equipment to ensure that they are tested for proper rotation. Some equipment cannot be run dry or in reverse. Please familiarize yourself with the equipment before operation.

To prepare the system to start:

1. Follow any guidelines set for maintenance and inspections.
2. Correct and clear any active alarms.
3. Ensure the Ozone Generator Power Level setpoint, located on the Home/PID Screen, is set to the desired value.
 - 3.1. To adjust the setpoint, click on the Select Gen Power Level field and enter the new value on the popup keypad, then press Enter to confirm the change.
4. When the system is ready to be activated, press the Start button on the Home/PID Screen.
 - 4.1. Once the System Start button has been pressed the 5 minute purge will start to clear the lines. When the purge is completed the Ozone Generators will begin creating Ozone
5. Use the needle valve on the right side of the panel to adjust the flow rate, which can be seen on the Mass Flow Meter.
 - 5.1. Optimal flow rate is 4 slpm.
6. The process can be monitored from the Home/PID.

3.2 CONTROL LOGIC

When an alarm is activated the system will stop and the red fault indicator on the front of the control panel will illuminate. Activated alarms are listed on the Alarm Screen. To clear an alarm, press the System Stop button located on the Home/PID screen of the HMI.

The following alarm conditions are preset and cannot be changed:

Feed Gas High - 30 psi

Feed Gas Low - 5 psi

Outlet Gas High - 25 psi

Low O2 Flow - 2.0 slpm

Ambient/Internal Ozone - 0.1 ppm

FEED GAS LOW FLOW - The supplied O2 Gas flow has dropped below the preset minimum flow and has shutdown the system.

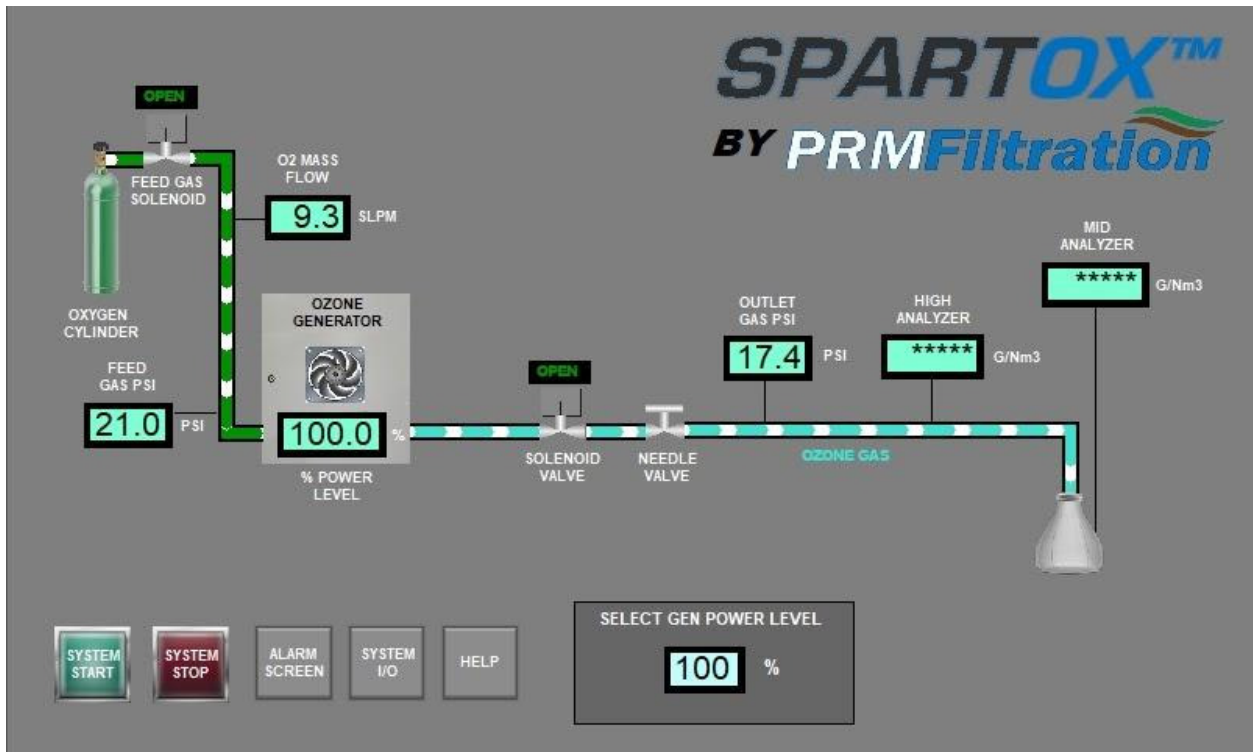
FEED GAS LOW PSI - The supplied O2 Gas pressure has dropped below the preset minimum PSI and has shutdown the system.

FEED GAS HIGH PSI - The supplied O2 Gas pressure has exceeded the preset maximum PSI and has shutdown the system.

OUTLET GAS HIGH PSI - The Outlet Gas pressure has exceeded the maximum PSI and has caused the system to shutdown.

OZONE GENERATOR FAULT - The Ozone Generator has faulted and has shutdown the system.

3.3 HMI SCREENSHOTS



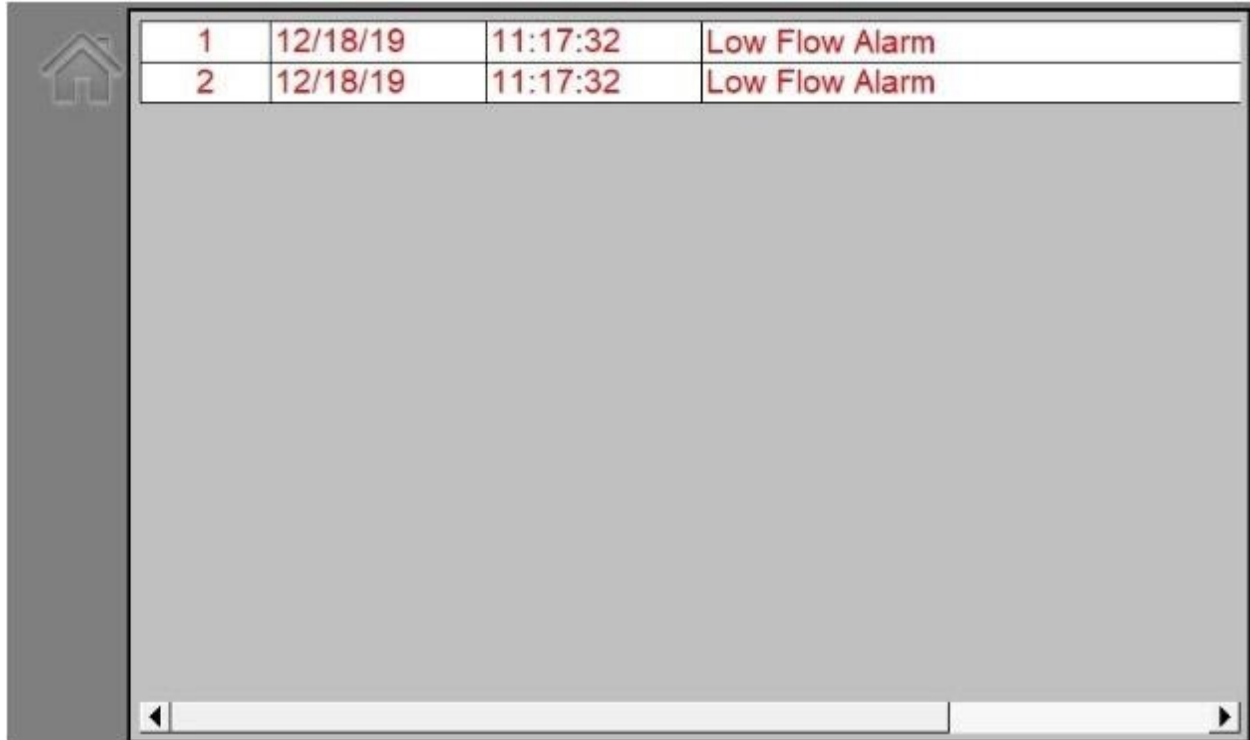
Home/PID Screen - This is the Home/PID Screen, from here the process can be monitored. The current Feed Gas PSI, O2 Mass Flow, Ozone Generator % Power Level, Outlet Gas PSI, High Analyzer and the Mid Analyzer levels as well as the solenoid positions are displayed.

To adjust the Ozone Generator Power Level, click on the corresponding field and enter the desired value on the popup keypad and press Enter to confirm the change.

Along the bottom left of this screen are the buttons that will allow the user to access the Alarm Screen, System I/O and the Help Screen.

Press the System Start button to begin the process starting with the purge.


The System Stop button is used to halt the process and to clear active alarms.



1	12/18/19	11:17:32	Low Flow Alarm
2	12/18/19	11:17:32	Low Flow Alarm

Alarm Screen - Here on the Alarm Screen, alarms that have been activated will have the name listed and the Date and Activation Time recorded and displayed. Once an issue has been resolved, press the System Stop button on the Home Screen to clear the alarm. To return to the Home Screen, press the House icon in the top left corner of the screen.

DISCRETE INPUTS PLC1		ANALOG OUTPUTS PLC6		DISCRETE OUTPUTS PLC1	
IN_1 OZONE GEN PRODUCING	ON	IN_1 % PWR SELECTION (mA)	20.0	OUT_1 NOT USED	ON
IN_2 OZONE GEN FAULT	OFF			OUT_2 SYSTEM FAULT	OFF
IN_3 NOT USED	OFF			OUT_3 SOFT CHARGE RELAY	ON
IN_4 NOT USED	OFF			OUT_4 O3 GEN I/O	ON
IN_5 REMOTE RUN	ON				
ANALOG INPUTS PLC3		ANALOG INPUTS PLC4		DISCRETE OUTPUTS PLC2	
IN_1 FEED GAS PSI (mA)	5.0	IN_1 O2 MASS FLOW (mA)	10.6	OUT_1 OUTLET SOLENOID	ON
IN_2 OUTLET PSI (mA)	4.9	IN_2 NOT USED (mA)	2.3	OUT_2 NOT USED	ON
ANALOG INPUTS PLC5				OUT_3 O3 POWER CIRCUIT	ON
IN_1 HIGH ANALYZER (mA)	2.3			OUT_4 O3 FEED GAS SOLENOID	ON
IN_2 MID ANALYZER (mA)	2.3				



System I/O Screen - On the System I/O Screen the current status of the Discrete Inputs and Outputs are shown. The Analog Inputs display the current readings of the transmitters. To return to the Home Screen, press the House Icon in the bottom right of the screen.



SPARTOX™
BY PRM Filtration

Click on the links below for assistance:



Help Screen - Every time the Help Screen is accessed a warning will be shown that informs the user that only qualified individuals should service this equipment. Once the 'I Accept' button has been pressed the Help Screen will be accessed. The buttons on the help screen are of issues that may occur. Press the desired button and suggestions on corrective actions that may resolve the issue will be displayed. To return to the Home Screen, press the House Icon in the bottom right of the screen.

4.0 SYSTEM MAINTENANCE

Daily Checklist

- Check the control panel for system status
- If available, connect to the system using the remote access capabilities to check system operation for the following:
 - Alarms
 - Operating
 - Temperature
 - Pressure

Weekly Checklist

- Check for leaks
- Check for excessive noise of various components
- Check for alarms
- Check and record pressures, temperatures
- Check for excessive moisture inside the control panels, transmitter boxes, and lines
- Check for corrosion and grease the moving parts if required to reduce corrosion

Scheduled Maintenance – Monthly

- Test critical inputs for proper shutdown setpoints
- Follow maintenance procedures for specific items as listed in the maintenance manuals
- Test the operation of the overloads

Annual Maintenance

- Test each input
- Test alarm conditions
- Test the operation of each output device
- Complete the weekly checklist

Major Components

This section can be used as a reference material to form a maintenance schedule for your system. These recommendations should be used in conjunction with the manufacturer's operating and maintenance manuals. Each site is unique and the maintenance schedule should be created to accommodate the specific site. Component manuals can be found on the flash drive System ID Card located in the technical drawings sleeve. Please return the flash drive after each use. **Always follow proper safety protocols, such as lockout/tagout procedures.**

Solenoid valves

- Test the operation of the solenoid valves
- Check to ensure valve seals are closed
- With the power off, remove the top and clean out any debris from the valve.

Electrical Boxes and Panels

- Open the box and check for moisture and condensation. Condensation can be a problem in humid climates that experience temperature fluctuations. The temperature change causes the box to breath and condensation will form inside. If high humidity is a problem, desiccant bags should be kept inside the box or panel to absorb moisture. These bags should be changed regularly. The desiccant will be blue when it is dry and orange when it is wet. The bag can be dried in a microwave or oven depending on the material.
- Check for proper grounding or leaks

Component Model and Serial Numbers, Replacement Part Numbers:

COMPONENT	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	REPLACEMENT ELEMENT P/N
OZONE GENERATOR	PTI	PBA-E1-UNIV-10-10 G-G2-137W-15PSI-1 LPM	200762269	
MASS FLOW METER	SERRIA	TOPTRAK 820		
COMPRESSED AIR THREADED FILTER	NANO	NF0008M01		E0008M01
SOLENOID	PRM	FDF20MS		
PLC	SIEMENS	LOGO!		
HMI	WEINTEK	MT8071IE	2001405812	

5.0 TROUBLESHOOTING

Analog 4-20mA Transmitters		
Symptom	Potential Cause	Possible Solution
Transmitter is sending a signal that is not accurate	There may be water in the air lines that is disrupting the reading	Drain moisture out of the air lines
	Transmitter and PLC ranges do not match	Verify that transmitter and PLC are identically ranged
	Transmitter may be out of Calibration	Refer to manual to calibrate transmitter
Transmitter is sending a 0-2mA signal to the PLC input	Transmitter may be improperly wired or wire connections may be loose	Check wiring against the device specification sheet and wiring schematic in manual. Check for loose connections
	Transmitter may be damaged	If you have a similar transmitter installed in another location on the system, switch the transmitters to determine if the faulty transmitter works in another location.
Transmitter sends out a signal over 20mA	Transmitter is faulty	Replace transmitter

LIMITED EQUIPMENT WARRANTY

PRM warrants its equipment to be free of defects in materials and workmanship for a period of 12 months from the date of completed manufacture. Equipment must be operated and maintained in accordance with the Maintenance manual provided with the equipment. This includes the site specific manual as provided by PRM as well as the individual component manuals with the guidelines established in the Operation & Maintenance manual provided. Warranty service shall not be applicable unless a complete logbook of monthly maintenance is kept. Warranty service shall not be applicable unless all outstanding invoices which are overdue are paid in full. To ensure equipment longevity all equipment must be protected from the elements.

In the event of a problem or failure, immediately contact PRM's corporate office and request technical assistance and have the PRM Project Number available. A technician will assist in determining if the equipment is operating properly and if not will guide the onsite technician in proper settings and adjustments. If a failure of a component has occurred, PRM will request the component be shipped back to PRM for repair or replacement. In the event that the repair requires PRM to be onsite for the repair, PRM will send a qualified technician to the site to make the repair.

PRM systems are thoroughly tested prior to shipment and we have an extremely low component failure record. Most calls are about equipment that has been incorrectly adjusted and a few minutes on the phone with the onsite technician can correct the problem. If there is a component failure, it is our commitment to the customer to remedy any problems as soon as possible.

All technical support matters are EXTREMELY important to PRM. We strive to make sure that all systems and equipment manufactured by PRM have high percentages of uptime and long life.

Sincerely,
Product Recovery Management

Mel Phillips
President

Mandatory: You are required to complete this form for warranty consideration

PRM is committed to using the highest quality control components in all of our systems. We only use copper wiring to ensure that we provide the utmost protection of all controls. Despite our attempts to ensure the safe operation of our systems, it is always possible for control components to become loose in transit or during operation. Any system that we ship should always be inspected at start-up, and all power conductors within the control panel should be re-torqued once the system has arrived on site.



Once power has been supplied to the system and it has been running for 1 week, all wiring should be re-inspected and re-torqued. During the early run time of any system, there is always a possibility of wires loosening as thermal expansion and contraction occurs with power cycles at the terminals. After 2 months of operation, this process should be completed again to ensure there are no abnormalities. PRM also recommends that this type of inspection is done yearly, or as frequently as needed, to ensure system integrity. If the system is relocated from one site to another, the entire inspection process should be repeated. This applies to rental systems as well.

If the system is under the warranty period provided by PRM, it is required that the client provide proof of these inspections to PRM in order to maintain the warranty. The proof of these inspections, and the results, should be provided to PRM as they occur. This proof should be provided through email with an attached inspection document (included) and an image of the panel interior. If a condition on site causes power terminal failure due to damage to the control panel components, and the client has not provided PRM with proof of these inspections in advance, the client accepts liability of costs necessary to repair the system. Please keep in mind that these failures can also lead to auxiliary equipment failures such as motors, resistive heaters, and other loads. In the event that a power anomaly occurs on site, such as lightning and other surges, PRM is not responsible for the downtime and/or loss of income due to such damages. It is the client's responsibility to mitigate and repair such damages as soon as possible. By operating the system after delivery, the client agrees to default to PRM's judgement in the event a disagreement occurs after such damages occur.

Only qualified technicians should be allowed to work inside of the system control cabinet or with other electrical components, and power should always be disconnected prior to conducting such work. PRM will always support the client to expedite repairs when possible.

Mandatory Electrical Inspection Form

Start-Up Inspection	Date: _____	Signature: _____
	Electrical Notes: _____	
Week 1 Inspection	Date: _____	Signature: _____
	Electrical Notes: _____	
2 Month Inspection	Date: _____	Signature: _____
	Electrical Notes: _____	
Annual Inspection	Date: _____	Signature: _____
	Electrical Notes: _____	

Please email the completed form to warrantyfulfillment@prmfiltration.com

REMEDATION EQUIPMENT TERMS OF ACCEPTANCE AND WARRANTY CARD

1. All remediation equipment supplied by PRM must be wired by a licensed electrician. The electrician to perform the work should be familiar with typical applications and all work must conform to the NEC. Failure to have a licensed electrician perform connections will void the system warranty.
2. All mechanical work should be done in a neat and orderly fashion without kinks and strains imposed on hoses and piping systems.
3. Each system supplied by PRM must be registered with PRM a minimum of 2 days prior to startup. This allows PRM to assign a technical support number to the project for start up and technical assistance. Failure to register the equipment will cause technical support delays.
4. Equipment supplied by PRM that will be powered by a generator will require low voltage protection across each phase. Equipment with electronic or solid state controls must be provided with clean power that is supplied with surge protection and appropriate equipment to provide a regulated power source. Failure to provide this power protection will void the warranty on the control system and possibly on the equipment itself.
5. Technical support is available 8:30am to 4:30pm Eastern Standard Time. Monday through Friday except for Holidays. Technical support offered after hours will be billable at a rate of \$85.00 per hour with a minimum 1 hour billing.

WARRANTY CARD WO-6024

WARRANTY CARD WO-6024

Site Name _____

Electrician _____ License No. / Ph. No. _____

Size of service _____ Conductors _____

THIS CARD MUST BE RETURNED TO PRM FOR TECHNICAL SUPPORT TO BE ACTIVATED.

TECHNICAL SUPPORT

SUPPORT

Technical support calls are handled on a case by case basis. When calling PRM for support, please have the PRM project Work Order Number (WO-6024).

PRM provides free technical support for warranty related repairs and issues. Technical support provided for troubleshooting assistance or training in system operation is not covered as free support.

Due to the high volume of troubleshooting calls, PRM will invoice for these support services. Fees for technical support are \$50 per support call up to 30 minutes. Additional phone based support is invoiced at \$85.00 per hour. Fees are subject to change without notice.

PROGRAMMING

PRM will modify system programs for a programmable logic controller (PLC) only by issuance of a purchase order or approved payment method if applicable. Certain PLC programming logic is proprietary information to PRM and PRM will not share logic that it deems proprietary. PRM will make logic changes to systems for a nominal fee.

If during the system warranty period, PRM finds a programming bug or error, PRM will make program repairs at no charge to the client.



FIGURES