SPARTOX™ by PRMFiltration

# Ozone Generator System

August 2020

# OPERATION AND MAINTENANCE MANUAL
# Manual WO-6208

**Prepared for:**

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

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***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 Injection 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 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 systems that are directly wired to power disconnects. Please tell the electrical contractor to contact PRM's 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.

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

## WARNING

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 contaminates. 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 $mg/m^3$). 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 30g Ozone Generator Panel Skid**

- Nema 3 enclosure with fan forced ventilation.
    - UL 508 listed panel
    - PTI solid state 30g/hr Ozone generator
    - LED indicators and HOA Switch
    - Dwyer Rotameter
    - 0-30 PSI Pressure gauge
    - 120V power feed required.Power relays for simplex operation
    - Power relays for simplex operation
- AirSep Topaz Ultra Oxygen Concentrator
    - 0-5lpm gas flowmeter, psig gauge and control valve
    - Oxygen Feed and Ozone Exhaust lines shall be pre-plumbed to the exterior of the cabinet.
- ATI F12/D Series Gas Detector mounted beneath the O3 panel
- Ozone Generator Panel and Oxygen Concentrator are mounted on a self supported skid

## 3.0 SYSTEM OPERATION

A SYSTEM OPERATION plan should be developed for the ozone injection 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 completedPrior to 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 alignment of all motors. They may come out of alignment during shipping.
9. Manually rotate motors to ensure they are not seized.
10. 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.
11. 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.
12. Check to ensure the panel is properly grounded and there is only one main source of ground.
13. Ensure all connections are properly sealed.

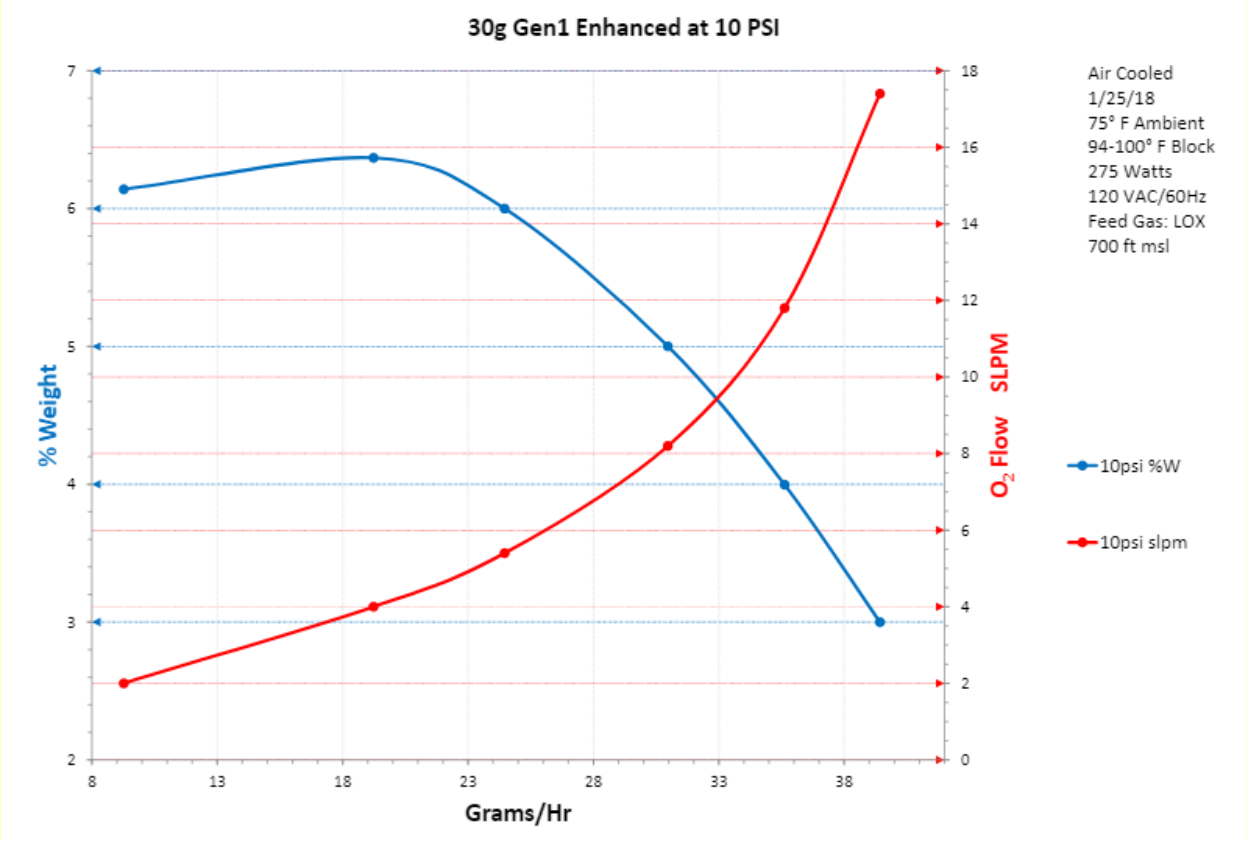
Ensure all necessary electrical approvals are in place before proceeding. Energize after all the items listed above have been completed.

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.
10. Remove motor fuses and test the operation of the logic without the motors actually running. Test the inputs with jumper wires.
11. Plug in the fuses for motors and check the valves in the system to ensure that all required valves are open and ready for operation. Check to ensure that no pumps will deadhead or starve for water.

## 3.2 OPERATION

Ozone is produced from oxygen concentrated from a Topaz+ pressure swing absorption (PSA) system with an integrated compressor (the Topaz+ manual is found in the Appendix of this manual). The oxygen in the gas from the PSA is converted into ozone inside the ozone generator at a concentration of approximately 5.5 wt. % at a rate of 30 gram ozone/hour. To achieve this production rate the gas flow rate as shown on the gas flow meter should be approximately 7 slpm. The back pressure on the ozone generator is in the range of 10-15 psi with the tested value at 10 psi. The Topaz+ flow meter was factory set at approximately 60% of full range at the generator pressure of 10 psi. Note that the Topaz+ unit should not be operated above 70% of their flow meter range since this will damage the oxygen concentrators.



Detailed information on the operation of the ozone generator can be found in the attached documents covering the Plasma Technics 30 g/h generator included in this binder.

There are three basic controls for the system: O2 gas flow, ozone generator pressure and the power setting via the potentiometer (factory setting) or a 4-20 mA/0-20 mA signal by connecting the analog control wires to the terminal block. The latter requires adjusting the jumper switches on the ozone generator circuit board. Refer to the attached electrical drawing for the ozone generator per the factory settings.

**EXTREMELY IMPORTANT !!!!!!!!!!!!!!!**

**Note: The generator should never be operated under power with gas pressure less than 5 psi since this can result in severe damage to the ozone generating cell.**

**Note: This generator must be operated with an oxygen feed of at least 85% oxygen and the balance inert gases such as N2 or Ar. Best performance is achieved with pure oxygen.**

**Note: In any event, the oxygen gas source must have a dew point of minus 60 degree F and preferably minus 100 degrees F. Most PSA type oxygen concentrators make oxygen with dew points of -100 degrees F. Check your oxygen source if you are buying oxygen gas for dew point information.**

**To operate the system:**

1. Connect power to the O3 Gen 30 via a 120 VAC single phase source. The unit draws approximately 5 amps.
2. Start the flow of oxygen by turning on the Topaz oxygen concentrator at the desired flow rate from 0-5 lpm. A setting of 4.7 lpm on the rotameter is equivalent to the 7 slpm required to produce 30 grams per hour of 5.5% ozone.

**Note: the flow meters were calibrated for air flow. The equation below converts desired oxygen flow to the settings on the flow meter.**

3. The gas pressure should be set at 10 psi for the desired gas flow using the needle valve.

**Note: The charts are based on ambient temperature of approximately 78 degrees F. Higher temperatures will decrease ozone production and lower temperatures will increase production, approximately 0.6% per degree for each degree above or below the figures in the chart.**

4. Let the oxygen gas flow for approximately 10 minutes before trying to power the unit. This time will insure that the unit is purged of impurities and moisture.

5. Using the power switch, turn on the generator, a green LED will illuminate. Using the potentiometer set the power for the generator. 100% power setting equates to 275 watts of power. The curve below shows potentiometer setting as it relates to percent power, it is not linear. Using the data in PTI data sheets, power setting and gas flow, you can select an ozone output.

**Note: Even at zero setting the generator will make a small amount of ozone if the inverter is on. If you do not want any ozone produced switch generator to the off position.**

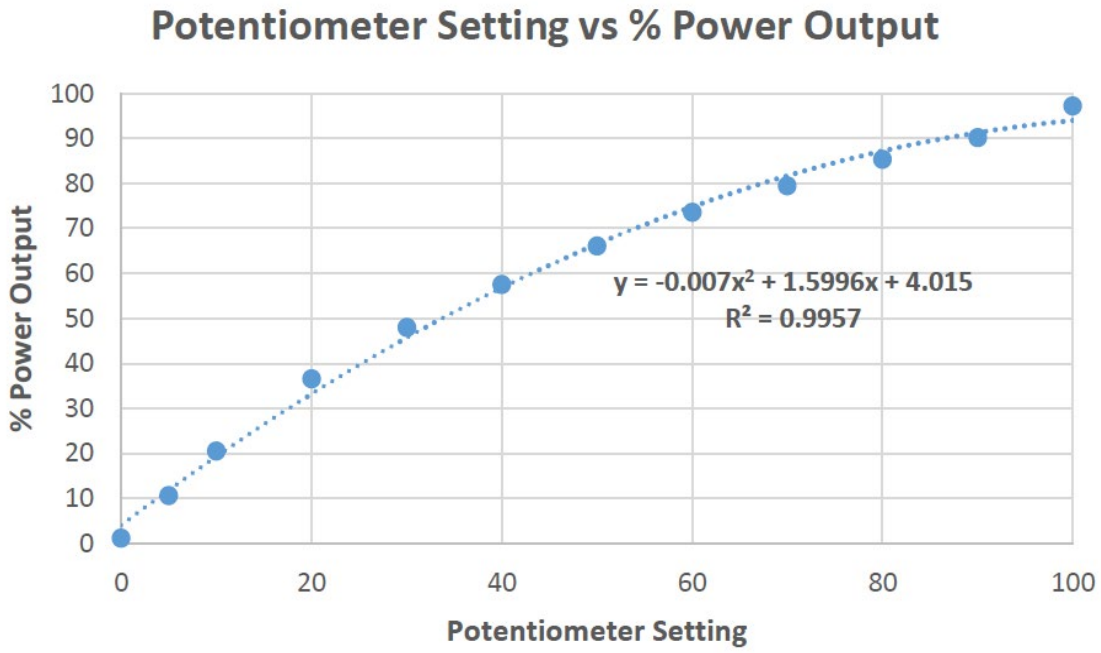
6. Typically, small ozone generators are operated at constant gas flow and varying power setting to adjust output.

## Gas Flow Conversion Calculation to Standard Conditions

The flow meter on the ozone generator is calibrated for air. To convert from gas flow at generator conditions to SLPM of oxygen use the following formula:
The equation to correct for nonstandard operating conditions is as follows:

$$Q_2 = Q_1 \times \sqrt{\frac{P_1 \times T_2}{P_2 \times T_1}}$$

Where:
Q1 = Actual or Observed Flowmeter Reading
Q2 = Standard Air Value Flow Corrected for Pressure and Temperature
P1 = Actual Pressure (14.7 psia + Gage Pressure, should be 20 psig)
P2 = Standard Pressure (14.7 psia, which is 0 psig)
T1 = Actual Temperature (460 R + Temp °F, generator environmental temperature)
T2 = Standard Temperature (530 R, which is 70°F)
The density between pure oxygen and air at standard conditions is
Air Density / Oxygen Density g/SL = 1.204/1.3271 = 0.907



**To shutdown the system:**

1. Toggle the On/Off switch for the ozone generator to the Off position.
2. Continue to let oxygen flow through the generator for one minute in order to “purge” the system of any remaining ozone.
3. Shutting down the Oxygen Concentrator:
    3.1. To stop oxygen delivery, rotate the flowmeter knob clockwise until the flowmeter registers zero.
    3.2. Set the l/O power switch to O.

### 3.3 SYSTEM ALARM

The system is equipped with an ATI F12/D series gas detector with an ambient ozone sensor. Detailed information on the operation of the gas detector can be found in the attached documents covering the ATI F12/D series gas detector included in this binder.

The gas detector has been set up to alarm and shut down ozone production when it senses an ambient ozone level of 0.1 ppm for a 10 second duration. The gas detector has been factory set to latch and not reset without operator intervention. The detector can only be reset from the face of the detector. The conditions that have been factory programmed to allow a reset are:

1. The ambient ozone level must be at 0.0 ppm
2. The 0.0 ppm must be sustained for at least 10 seconds

If ambient ozone levels reach the 0.10 ppm threshold, the source of the ozone leak needs to be investigated. High ozone levels are hazardous to not only people, but to equipment and objects within the elevated ozone level area.

# 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
        - Vacuum

**Weekly Checklist**

- Check for leaks
- Check for excessive noise of various components
- Check for alarms
- Check and record vacuums, 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.**

**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

**AirSep Oxygen Generator**
The oxygen generator requires little maintenance. Use the following chart as a guide to perform preventive maintenance at the required intervals.

Interval Maintenance:
**Every two weeks**

1. Clean gross particle filter.

**Every month**

1. Make sure product oxygen remains within specifications in Appendix A of the AirSep Topaz instruction manual. If product oxygen does not meet specifications, refer to Section 8.0 Troubleshooting for .
2. Clean enclosure.
3. Every month Check performance of solenoid valves.

**Cleaning the Gross Particle Filter**
Clean the gross particle filter on the right side of the oxygen generator enclosure every two weeks, or more frequently if site conditions warrant. A clean filter allows the unit to cool properly.

Use the following procedure to clean the gross particle filter:

1. Shut down the oxygen generator
2. Disconnect the power cord from the electrical outlet.

**Note:** Do not operate the unit without the gross particle filter in place.

3. Remove the filter, and insert the second filter provided with the unit.
4. Connect the power cord to the electrical outlet.
5. Restart the unit
6. Wash the filter removed from the unit in a solution of soap and warm water.
7. Rinse the filter thoroughly and remove excess water with a soft, absorbent towel.
8. Allow the filter to dry, then store it in a clean location. Alternate the clean filter with the filter on the unit each time you perform this procedure.

**NANO NF 0008 Filter**

The NANO filter is a 0.01 micron coalescing filter and should be inspected monthly for signs of particulates. If excessive fouling is observed, the filter element should be replaced. At a minimum, the filter element must be replaced annually.

**Cleaning the Enclosure**

**Note:** To prevent electrical shock, shut down the oxygen generator and disconnect the main power supply before cleaning the enclosure.

Use the following procedure to clean the enclosure:

1. Shut down the oxygen generator.
2. Disconnect the power cord from the electrical outlet.
3. Use a dry, lint-free cloth on the enclosure, taking care to wipe the enclosure clean.

**Note:** Dry cloth clean only. Do not apply liquid directly to the enclosure or use any petroleum-based solvents or cleaning agents.

## Component Model and Serial Numbers, Replacement Part Numbers:

| COMPONENT | MANUFACTURER | MODEL NUMBER | SERIAL NUMBER | REPLACEMENT ELEMENT P/N |
|---|---|---|---|---|
| OZONE GENERATOR | PTI | PBA-A1-120V-1 0-30G-G1E-250W10 PSI-5 SLPM-D21-X | 3SMU | |
| OXYGEN CONCENTRATOR | AIRSEP | AS123-8 | 2857320-2 | |
| AMBIENT OZONE MONITOR | ATI | F12-3-1-1-1 | 1924 | |
| .01 MICRON FILTER | NANO | NF0008M01 | | E0008M01 |
| ROTAMETER | DWYER | VFA-23-SSV | | |
| NEEDLE VALVE | PRM | SSNEEDLEVLV025X | | |

# 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 clients 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**

# REMEDIATION 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-6208**

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**WARRANTY CARD WO-6208**

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-6208).

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.

CELEBRATING 25 YEARS PRM® PRODUCT RECOVERY MANAGEMENT

# FIGURES