

RMT-1500 MOBILE OZONE GENERATION TRAILER

MODEL: RMT-1500, 16-OUTPUT INSTALLATION & OPERATIONS MANUAL





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IMPORTANT SAFETY INSTRUCTIONS, READ AND FOLLOW ALL INSTRUCTIONS. Read this manual completely before attempting installation. SAVE THESE INSTRUCTIONS.



SECTION 1

SAFETY PRECAUTIONS

Ozone is a powerful oxidizing agent. Observe strict operating procedures while using ozone equipment. It is imperative that only ozone compatible materials are used in conjunction with the ozone system.

NOTE: If the operator has asthma, he or she must not enter an airspace that has a significant ozone concentration. Ozone can induce an asthma attack.

Ensure that the Ozone Generator is in a well-ventilated area. Do not allow rain or condensation to contact the Ozone Generator. The Ozone Generator is not weather proof. The unit must be operated indoors or in an enclosure in a non-condensing environment.

Carefully review and familiarize yourself with the following important safety information concerning the Ozone Generator:

- Ozone is an extremely aggressive and powerful oxidizer. The Occupational Safety and Health Administration (OSHA) 8 hour exposure limit is 0.10 PPM. The OSHA 15 minute exposure limit for ozone is 0.3 PPM. Above 0.3 PPM, there is the risk of damage to respiratory tissues.
- 2. People who have no sense of smell should not operate this equipment.
- 3. Never attempt to verify ozone production by directly breathing or smelling the ozone outlet.
- 4. The Ozone Generator contains high voltages. Unauthorized entry can result in serious injury or death. For service instructions, contact Ozone Solutions.
- 5. Make sure all connections are secure and are not leaking. Failure to do so could result in the discharge of ozone into an undesired space.

The RMT-1500 contains oxygen sieves for the production of high concentration oxygen to supply the ozone generator.

Although oxygen itself is not combustible, it can be very dangerous. It greatly accelerates the burning of combustible materials. Precautions should be taken to avoid a fire in the area of the generator.

- 1. Smoking should not be permitted in the area where the generator is located.
- 2. All oxygen connections and hoses should be kept clean and free of grease, oil, and other combustible materials.
- 3. Valves controlling oxygen flow should be opened and closed slowly to avoid the possibility of fires or explosions that can result from adiabatic compression.
- 4. When bleeding a tank or line, stand clear and do not allow oxygen to embed itself within clothing. A spark could ignite the clothing violently.

High pressure gases may be present within the system. Valves should be opened and closed slowly. Safety glasses and hearing protection should be worn at all times while gases are being vented.

Do not attempt to modify or enhance the performance of the Generator in any way.

INTRODUCTION

The RMT ozone generation trailer produces ozone from oxygen via corona discharge. It is capable of producing up to 1,500 grams per hour of ozone with a feed gas of 90% oxygen.

This system is designed to work as a standalone unit with all necessary equipment and automation for ozone production built into one mobile platform. The system consists of the following major components:

- Air Compressor (built-in air dryer)
- Compressed Air Filters
- Oxygen Concentrator
- Compressed Air and Oxygen Buffer Tanks
- Ozone Generation Cabinet
- Cooling Water Chiller
- Well Output Manifold/Automated Valves

THEORY OF OPERATION

The air compressor takes ambient air and increases the pressure to 125 PSI, while the attached air dryer reduces the moisture content. The compressed air is filtered and stored in a buffer tank to level out the pressure and allow the compressor to operate more smoothly.

The compressed air is fed into the oxygen concentrator where nitrogen (about 71% of air) is separated out using a cycle called Pressure Swing Adsorption. This process uses two sieve beds filled with a particular zeolite that traps nitrogen as pressure builds. When pressure drops rapidly, the nitrogen is released. The two sieve beds operate in an alternating fashion to supply high purity oxygen into an oxygen buffer tank. The waste nitrogen is released to atmosphere.

The oxygen stream then flows through corona discharge generation cells, where some of the oxygen molecules are broken down from O_2 into O^2 ions. Some of these ions then bond with each other back into O_2 , while the others bond with O_2 to form O_3 .

Ozone is then sent to a series of manifolds where it can be divided into a number of output zones. Each zone is equipped with a motorized ball valve, pressure gage, flow meter with needle valve, and check valve.



Each zone can be individually activated or deactivated electronically. Flow through each zone can be manually adjusted via the needle valve as well.

The ozone generation cells produce heat as a byproduct of the generation process. Excessive heat is destructive to the cells themselves, so a water cooling circuit is necessary. A water chiller provides the necessary cooling capacity for the ozone cells.



COMPONENT DESCRIPTION

- 1. Air Compressor: The 20 horsepower air compressor provides 88 CFM of compressed air at 125 PSI. The compressor includes a built-in air dryer that removes moisture from the compressed air stream, and purges it out the floor of the trailer.
- 2. Compressed Air Filters: These filters remove fine particulate matter from the compressed air stream to preserve and protect downstream components.
- 3. Compressed Air Storage Tank: Compressed air fills the 200 gallon air tank. The tank smooths out small pressure oscillations induced by the compressing process, as well as allowing the compressor to operate in more stable on-off cycles.
- 4. Oxygen Concentrator: The oxygen concentrator separates oxygen (21% of atmospheric air) from nitrogen (78% of atmospheric air). It utilizes an alternating process of building and purging pressure in two sieve beds, called Pressure Swing Adsorption. The beds are filled with a special zeolite material that traps nitrogen at higher pressures, and releases it when pressure drops again. The oxygen concentrator will produce about 175 lpm of 93% pure oxygen.
- 5. Oxygen Storage Tank: Oxygen fills the 200 gallon oxygen storage tank. The PSA process does not produce a constant stream of oxygen, so the oxygen tank provides a buffer and smooths out flow and pressure to the ozone cells.
- 6. Ozone Generators: The system utilizes 3 watercooled ozone blocks, each capable of up to 600 g/hr in ideal conditions. The blocks contain a

controlled spark, called a corona, to convert some of the oxygen stream into ozone. The cells are typically set up for approximately 6-8% ozone by weight, however higher concentrations are possible by reducing the oxygen flow rate.

- 7. Ozone Manifolds: The ozone/oxygen stream exits the generation cabinet and is distributed to two manifolds controlling 8 zones each. A motorized ball valve controls flow at each zone.
- 8. Flowmeter Banks: Each zone has a manual needle valve, analog flow meter, and analog pressure gauge on the flow meter banks. Individual zone flows can be monitored and adjusted manually via these banks.
- Cabinet Air Conditioner: The ozone generation cabinet has an 8,000 BTU/hr capacity air conditioner mounted to the top. This air conditioner maintains a cool and dry environment in the cabinet to prevent damaging condensation on the water cooling lines and heat transfer plates on the ozone cells.
- 10. Trailer Air Conditioner: Mounted on the front face of the trailer is a 5-Ton capacity air conditioner which works to keep the trailer cool inside. Excessive heat introduces problems with components overheating.
- 11. Water Chiller: The ozone generation cells require cooling water through heat transfer plates to prevent damage from heat. The water chiller cools and circulates the water. Its pump circulates up to 12 gallons per minute of cooling water and has a cooling capacity of 5 tons.

SECTION 2

INSTALLATION GUIDELINES

The RMT-1500 is designed to be located outdoors and withstand most typical environmental conditions. The control system has built-in safety measure to prevent equipment damage in the event of extreme conditions.

The trailer should be located in such a way as to allow access to the well output connections on the outside. The output connections are located on the street-side face, toward the rear of the trailer.

Adequate space around the trailer should be provided for egress and equipment service access, especially around the doors of the trailer. Various components within the trailer produce significant heat during operation. These components require fresh air intake and hot air exhaust. The trailer should not be positioned in tight alleyways or areas with poor airflow.

VENTILATION

The system should be installed in a well-ventilated area. The compressor and water chiller have intake and exhaust vents on the sides of the trailer. The ozone leak fan also vents air out the side of the trailer in the event of an ozone leak. The air conditioner circulates air through its own vents at the front of the trailer. Proper ventilation ensures that heat or ozone does not build up in areas near the trailer.

Rubber is particularly vulnerable to contact with ozone. Accumulated ozone will degrade the trailer tires over time. In order to maintain road-worthiness of the trailer, ventilation is critical.

LOCATION

The system is designed as a mobile unit, and will operate free-standing on level surfaces. For proper operation and safety of the equipment, it should only be operated in areas without excessive dust, debris, and spray.

Various internal components periodically purge or drain accumulated condensate water. This occurs through the floor of the trailer. The trailer should be located where this water can drain away or evaporate without pooling and remaining stagnant.

SYSTEM DEPLOYMENT

- 1. Upon arrival, the ozone generation trailer should be parked on a solid and level platform. It is acceptable to leave the trailer on its wheels, however heavy duty jack stands underneath the chassis could greatly benefit the stability of the trailer.
- 2. Apply wheel chocks to forward and backward directions of the wheels on one or both sides of the trailer.
- 3. Lower the attached trailer tongue stand to the ground level in order to lift it off of the tow vehicle's hitch. Once separated from the tow vehicle, adjust the tongue stand to bring the trailer floor as close to level as possible.

- 4. On the aft, curb side of the trailer are the intake and exhaust vents for the air compressor. Attach the provided louver flap to the hinges on the exhaust louver, and use the chains to hold it in place. It should be angled anywhere from level to 30 degrees above level. This flap prevents recirculation of warm exhaust air back into the intake of the compressor.
- 5. Remove any other covers applied to vent louvers on all sides of the trailer.
- 6. Connect desired fittings and tubing to any and all desired output wells on the output panel. These fittings are 3/8" female NPT ports. Use only ozone compatible fittings and tubing, such as stainless steel, kynar, and FEP.
- 7. Connect electrical power to the disconnect box on the front face of the trailer. Be sure that wires are not energized and the disconnect is in the "OFF" position while working with power wires. Review the "Electrical Power Connections" section of this manual for more information.
- 8. When all previous deployment steps have been carried out and double checked, move the disconnect switch to the "On" position to supply power to the trailer.
- 9. Proceed to the "Operator Startup" section of this manual, and perform the listed steps. Return to this list upon completion.
- 10. Perform a check of all tubing and hose connections to ensure there are no leaks. A spray bottle filled with slightly soapy water can be used to detect leaks on pressurized lines. Spray a small amount at the tubing connection. Spattering and foaming indicates air, oxygen, or ozone is leaking from that connection.

PREPARING FOR TRANSPORT

In the event that the trailer needs to be removed from the site, follow these steps to prepare the trailer for transport.

- 1. Perform the shutdown procedures as listed in the "Operator Shutdown" section of this manual.
- 2. Disconnect power using the switch on the disconnect junction box on the front face of the trailer.

- 3. Disconnect power lines inside the disconnect junction box. Be sure the wires are not energized while working inside the box.
- 4. Remove ozone connections and fittings from the output well panel. Cover each port with tape or NPT plugs to prevent contaminants and damage to threads.
- 5. Disconnect chains or brackets from the compressor exhaust flap and remove it from the exhaust louver.
- 6. Place tape across the leak fan louver to prevent it from flapping in transit.
- 7. Securely close all doors and latch them.
- 8. Attach trailer to tow vehicle and raise tongue stand all the way. Use a properly sized ball hitch and use safety chains.
- 9. Remove any installed jacks and wheel chocks.
- 10. Ensure tire pressures are within specified limits and trailer lights are functioning.

OZONE CONNECTIONS

Gaseous ozone is supplied from a series of 3/8" NPT ports on the outside of the trailer. There are a total of 16 individually controlled "zones", each with its own outlet. The panel containing these outlets can be found on the street-side wall of the trailer, toward the rear. Each outlet is labeled to indicate which zone it corresponds with.

Each individual well output has its own check valve to prevent water backflow into the trailer from the end use. These check valves will need to be monitored and potentially replaced yearly.

ELECTRICAL POWER CONNECTIONS

ATTENTION: Air compressor rotation is critical. Ensure proper rotation of air compressor motor as marked on the compressor - before starting the Ozone System.

Power Requirements

RMT-1500	Power Requirements
Voltage	120/208-240V three- phase
Full Load Amperage	~125A per phase
Overcurrent Protection	200A (in power distribution panel)
Maximum Power Consumption	~45 kVA at full production

Main Supply Power Connections

Inside the Power Distribution Panel is a Main Disconnect switch located toward the bottom of the panel.

Connect the incoming L1, L2, L3 to the appropriate terminals in the panel. High Leg or Wild Leg connects to L3 if necessary.

Connect Neutral Conductor to the Neutral Bar inside the panel.

Connect equipment ground terminal in panel to earth ground. If local conditions deem necessary, bond the neutral and ground within the Power Distribution Panel.

SPECIFICATIONS

RMT-Series	RMT-1500
Trailer Box Dimensions	20'x8'x8'
Ozone Production	1,500 g/hr
Number of Well Outputs	16
Well Output Connections	3/8" FNPT
Air Compressor	20HP with Air Dryer
Oxygen Production	175 lpm
Ozone Cells	3x 600g/hr water cooled
Water Chiller Capacity	60,000 BTU/hr
Trailer Cooling Capacity	60,000 BTU/hr
Cabinet Cooling Capacity	8,000 BTU/hr

SECTION 3

OPERATION GUIDELINES

After the system is properly configured, start-up and shutdown are very simple tasks from an operator standpoint, and very little operator intervention is required. The operator presses START on the main HMI screen, and from there the operation is completely automatic.

The automated control system will function to operate the entire generation trailer and protect system components from such things as low air pressure, low oxygen pressure, high temperature, and ozone leaks. The sensors within the trailer monitor the operating environment and adjust the system accordingly, provided that none of the components are manually overridden.

OPERATOR STARTUP

NOTE: If startup does not occur as expected, refer to the "Configuration" or "Alarms & Troubleshooting" sections in this manual.

- Ensure all manual air, oxygen, and cooling water isolation valves are open (except those provided as test ports or equipment drain valves).
- Ensure that front and rear trailer doors remain closed during operation. The trailer cabin is a climate controlled environment.
- The MAIN SCREEN should be visible on the HMI control panel of the generation cabinet. Push START.
- After a short delay, the air compressor should start. Observe the dry air pressure readings and ensure they begin to climb above 90 PSI. There is an analog gauge on the tank, as well as a digital readout on the HMI.
- The oxygen concentrator should start when pressure has been built up. Observe the O₂ storage tank pressure to ensure they begin to build. It could take more than 15 minutes for oxygen pressure to build to above 45 PSI.
- When adequate oxygen pressure is achieved in the oxygen storage tank, ozone production can begin.

OPERATOR SHUTDOWN

- Push the STOP button on the main HMI. Do NOT use any E-Stop switches on any equipment for routine shutdown, as proper shutdown procedure may not occur.
- Allow the system to run through its automatic shutdown and flushing sequence. The system will do an oxygen flush to get rid of ozone within system lines. When the HMI panel indicates a START button again, the shutdown sequence is complete.
- If the trailer is being disconnected, moved, or shut down for extended periods of time, drain the air and oxygen storage tanks via the test port manual ball valves. This should also be done before any service work begins on any pressurized lines, ports, or main stream components.

SECTION 4

HMI MAIN SCREEN



- 1. Compressed Air Tank Pressure: the current pressure of compressed air in the storage tank ready for oxygen separation.
- 2. Oxygen Tank Pressure: the current pressure of oxygen in the storage tank ready for ozone generation.
- 3. Regulated Oxygen Pressure: an automated pressure regulator reduces pressure to a set value, which is indicated here on the HMI.
- 4. Cell Output: a percentage value for the power being applied to the ozone generation cells. Zero output means oxygen is flowing through and no ozone is being produced.
- 5. Start Button: this button starts feeding the cells with oxygen and begins ozone production (if output is set greater than 0%).
- 6. Measured Cooling Water Temp: the temperature of the water coming from the water chiller, heading toward the ozone cells.
- 7. API-454 Measurement: continuously measured concentration of ozone being produced. Typically low, often in the 6-8% range.

- 8. Alarm History Button: takes you to the alarm history screen on the HMI. Alarm information and acknowledgment will occur on this screen.
- 9. Setpoints Button: takes you to the setpoints screen on the HMI. System configuration settings can be altered here.
- 10. Manual Operation: takes you to the manual operation screen on the HMI. Individual components such as the ozone cells can be enabled or disabled for service/troubleshooting purposes.
- 11. Output Valve Operation: takes you to the output valves screen on the HMI. Information and control over individual output zones is available here.
- 12. Concentrator: takes you to the oxygen concentrator operation screen on the HMI. This screen will have information on concentrator status and operation.
- 13. Trailer Environment: these values indicate measured environmental characteristics of the inside of the trailer to monitor air conditioner effectiveness. The temperature and relative humidity measurements are displayed.

HMI ALARM HISTORY SCREEN

Login Logout User:Supervisor		10/3/2019 11:00:15 AM
Alarm time Acknowledge 10/3/2019 10 42-56 AM 10/3/2019 10 42:00 AM * 10/3/2019 10 22:13 AM * 10/3/2019 9:59:24 AM	Alarm History Image Message Cabinet Leak Alarm / Run Leak Fan Then Contuine Manifold Leak Alarm / Run Leak Fan Then Contuine O2 PSI Low / Shutdown Air PSI Low / Shutdown	
Main Overview	16 Rest All Alarms	17 Shutdown

- 14. Alarm History Field: lists the active and past alarms that have been triggered, as well as a short message on corrective action.
- 16. Reset All Alarms: Acknowledges all alarms.
- 17. Shutdown: Shuts the system down for corrective service and maintenance repairs.
- 15. Main Overview Screen: returns user to the main HMI screen.

HMI SETPOINTS SCREEN

Login User:Supervise	Logout	6		NE DNS.	10/3/2019 -	11:01:00 AN	Λ
		Se	etpoint	S			
Dry Air PSI Start Set Point	100	18			System Flush Seconds	35	23
O2 Flow Start Set Point	50				Air Tank Drain Valve Interval Minutes	60	24
O2 PSI Start Set Point	50	19			O2 PSI SetPoint	42	25
Cell Water Temp Alarm	85	20					
		O2 Flow Stop Set Point	35	21			
		O2 PSI Stop Set Point	45	21			
		Dry Air PSI Stop Set Point	75	22			
Main	26				System Idl	8	

- 18. Dry Air Pressure Start: minimum pressure, as measured in the compressed air tank, required for concentrator start.
- 19. Oxygen Parameters Start: minimum pressure and flow of oxygen required to start ozone production.
- 20. Cell Water Temp Alarm: maximum incoming water temperature. Temperatures above this value triggers an alarm condition.
- 21. Oxygen Parameters Stop: minimum pressure and flow of oxygen during operation. Values below these setpoints trigger alarm conditions.
- 22. Dry Air Pressure Stop: minimum pressure allowed during operation. Values below this setpoint triggers an alarm condition.
- 23. System Flush Time: length of time, in seconds, that oxygen flows through the system to purge ozone on shutdown.

- 24. Air Tank Drain Interval: length of time, in minutes, between purges of the air tank drain.
- 25. Oxygen Pressure Setpoint: pressure at which the automated pressure regulator supplies oxygen to the ozone cells.
- 26. Main Overview Screen: returns user to the main HMI screen.

HMI MANUAL OPERATION SCREEN

Login Logout User:Supervisor		10/3/2019 11:01:40 AM	
	Manual	×	Shut Down HMI Program
27 Drain Air Tank	87 PSI		
Gen 1 Enabeled			
Cen 2 Enabeled			
Gen 3 Enabeled			
Main 29		System Idle	

- 27. Drain Air Tank: opens the solenoid valve on the dry air tank to purge built up condensate. The measured tank pressure is displayed next to this button.
- 28. Generator Disable: allows the disabling of individual ozone generation cells for service or troubleshooting purposes.
- 29. Main Overview Screen: returns user to the main HMI screen.

HMI OUTPUT VALVE SCREEN

		Login		Logo	ut		~	20			IE		1	0/3/201	9 11:02	2:57 A	M		
	US	O3 SetPt	30 VIS		32	33			34	TION	V S . O3 Level	03 Level							
Z	Zone 1	7one #1 0.10	Zone#2 0.00	Zone Disabled	03 Control Enabled	03 Control Zone #2	03 HR	03 Min 15	Reset Counters	Zone 9	Zone#1 0.00	Zone#2 0.00	Zone Enabled	03 Control Disabled	03 Control Zone #1	03 HR 152	O3 Min	Reset Counters	
Z	Zone 2	0.00	0.00	Zone Disabled	03 Control Enabled	03 Control Zone #2	0	0	Reset Counters	Zone 10	0.00	0.20	Zone Enabled	03 Control Disabled	03 Control Zone #1	152	15	Reset Counters	
Z	Zone 3	0.10	0.00	Zone Disabled	03 Control Enabled	03 Control Zone #2	0	15	Reset Counters	Zone 11	0.00	0.00	Zone Enabled	03 Control Disabled	03 Control Zone #1	152	5	Reset Counters	
Z	Zone 4	0.00	0.00	Zone Disabled	03 Control Disabled	03 Control Zone #1	0	0	Reset Counters	Zone 12	0.00	0.10	Zone Enabled	03 Control Disabled	03 Control Zone #1	152	5	Reset Counters	
Z	Zone 5	0.10	0.00	Zone Disabled	03 Control Disabled	03 Control Zone #1	0	15	Reset Counters	Zone 13	0.00	0.00	Zone Enabled	03 Control Disabled	03 Control Zone #1	152	5	Reset Counters	
Z	Zone 6	0.00	0.00	Zone Disabled	03 Control Disabled	03 Control Zone #1	0	0	Reset Counters	Zone 14	0.40	0.10	Zone Enabled	03 Control Disabled	03 Control Zone #1	152	11	Reset Counters	
Z	Zone 7	0.10	0.02	Zone Disabled	03 Control Disabled	03 Control Zone #1	0	13	Reset Counters	Zone 15	0.00	0.00	Zone Enabled	03 Control Disabled	03 Control Zone #1	152	5	Reset Counters	
Z	Zone 8	0.00	0.00	Zone Disabled	03 Control Disabled	03 Control Zone #1	0	0	Reset Counters	Zone 16	0.00	0.10	Zone Enabled	03 Control Disabled	03 Control Zone #1	152	6	Reset Counters	
								O3 Level	O3 Leve	1									
		Mair	1	35				Zone #1	Zone #2	1					System Idle				

- 30. Ozone Setpoint: these values determine the ozone monitor setpoint at which the output well valve will close. Each output can be controlled by the feedback of ozone monitors at one of two locations (zone 1 or zone 2).
- 31. Output Zone Status: this indicator will show whether the output well valve is open or closed, allowing ozone to flow through.
- 32. Ozone Control Status: this indicator shows whether the output of a specific well is controlled by the feedback from one of the monitors. If disabled,

it will be open or closed regardless of monitor feedback. If enabled, it will close when the specified monitor reads a high ozone concentration.

- 33. Control Zone Selector: this button allows the user to choose which monitor controls the output of a particular well.
- 34. Counter Reset Button: resets the time counter.
- 35. Main Overview Screen: returns user to the main HMI screen.

HMI CONCENTRATOR SCREEN



- 36. Valve Indicators: shows whether a valve is open or closed based on the color of the indicator.
- 37. Sieve Bed Pressure: indicates the current pressure within the given sieve bed.
- 38. Time Remaining: Counts down the time remaining in the current step of the PSA process.
- 39. Oxygen Tank Pressure: displays the measured pressure in the oxygen storage tank.
- 40. Main Overview Screen: returns user to the main HMI screen.

SECTION 5

PERSONAL SAFETY

Flushing Ozone from the System

Safety warnings regarding ozone gas are found at the beginning of this manual, and a Safety Data Sheet can be found in the appendices. The Ozone Remediation Trailer produces a large amount of ozone which can be inadvertently stored within the ozone cells, manifolds, and ozone lines.

Eventually the ozone will safely revert back to oxygen, as ozone is not a stable molecule. Under the right conditions, ozone can remain in the system for 24 hours or more. In the event that service or repairs are necessary, it is recommended to take the following steps:

- Whenever possible it is recommended that the machine run with maximum permissible air/ oxygen flow for at least 10 minutes with the ozone generation cells OFF.
- If the machine cannot be operated prior to maintenance or repair, a waiting period of at least 12 hours should occur to allow the ozone to decay. The longer you wait, the safer it will become. Be sure to keep an ambient ozone monitor nearby to detect when ozone exceeds safe levels.

Isolating Energy Sources

The Ozone Remediation Trailer has electrical and mechanical hazards, and maintenance or repair should not take place unless all energy sources have been turned off, disconnected, and/or drained. Energy sources include, but are not limited to:

- Electrical Power
- Electrical energy in generator capacitors
- Compressed air in storage tank
- Compressed oxygen in storage tank
- Compressed gases in oxygen concentrator
- Chemical energy in ozone

Equipment Damage Concerns

With normal use of the system as instructed by Ozone Solutions, and as outlined in this manual, the Ozone Remediation Trailer is monitored and protected to prevent damage to the equipment. Even with these protective measures, it is possible to cause equipment damage in the event of operator error or lack of maintenance. It is important that personnel do not alter or reconfigure the system without first seeking advice from Ozone Solutions.

SECTION 6

WARRANTY

Ozone Solutions warrants all equipment assembled, manufactured, and sold to be free from defects in material and workmanship under normal use and service for a period of one (1) year after date of sale to the original purchaser.

Some products may have a specific warranty period other than what is outlined in this document. For such products, the manufacturer warranty will supersede this warranty. Ozone Solutions will honor the manufacturer's warranty, but if and when advised by the manufacturer, may have the customer deal directly with the manufacturer. This warranty covers all parts that are not outlined in a product maintenance schedule. This warranty will be void if any piece of the equipment is used in a manner other than what is explicitly outlined in the product manuals.

If any part of the equipment manufactured by Ozone Solutions proves to be defective during the warranty period, please call Ozone Solutions at 712.439.6880, or email service@ozonesolutions.com.

Prior authorization is required before working on or shipping a product back to us. Failure to get prior authorization may result in denial of your claim. Once authorized, you may return the defective equipment to Ozone Solutions with the transportation charges prepaid. If Ozone Solutions finds the equipment to be defective, it will be repaired or replaced at our discretion, free of charge, to the original purchaser (F.O.B. factory).

This warranty shall not place any liability on Ozone Solutions for any transportation charges, labor, or cost for, or during the replacement of any parts. The replaced part(s) or product will then continue the original warranty duration. The replaced parts will not start a new one (1) year coverage period. The purchaser by acceptance of the equipment will assume all liability for the consequences of its use or misuse by the purchaser, employees, or others. This warranty shall not apply to any piece of equipment, or part thereof sold by this company which has been subject to any accident caused in transit, alterations by unauthorized service, negligence, abuse, or damage by flood, fire, or act of God.

This warranty shall constitute the entire warranty and/ or agreement between Ozone Solutions and the original purchaser, and in lieu of all other warranties, expressed or implied, either oral or written, including the warranty of merchantability and fitness for a particular use and of all other obligations or liabilities on our part. Ozone Solutions neither assumes nor authorizes any other person or entity to assume for us any liability associated with the sale of its products or equipment.

The term "original purchaser," as used in this warranty, means whom the product was originally sold to by Ozone Solutions or by an authorized dealer. Ozone Solutions reserves the right to make changes in its products without notice. Because of this, Ozone Solutions is not obligated to replace warranty defective part(s) and/or product with the same original part or product.

CONTACT INFORMATION

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APPENDIX A - PROCESS DRAWING



APPENDIX B - SYSTEM DRAWING



APPENDIX C - MAINTENANCE

All major components requiring maintenance have guidelines listed in the respective operation manuals. Refer to those individual operation manuals for detailed preventative maintenance and regular maintenance information.

Major components which have their own operations manual are listed below:

Component	Manufacturer	Model Number
Compressor	Kaeser	SK 20T
Oxygen Concentrator	Preservation Tech	0XGS-175
Water Chiller	Advantage Engineering	MG-4A
Air Conditioner (Trailer)	Bard	W60A2
Air Conditioner (Generation Cabinet)	Ice Qube	IQ8000T

Maintenance Table

Time Period	Component(s)	Action	Part Number(s)
Every Startup	Entire System	Ensure normal pressures and flows	
		Check for leaks	
Monthly	Intake & Exhaust Grilles	Check operation	
		Clean vents	
	Drain Valves	Test proper actuation	
	Ozone Valves	Test proper actuation	
	Oxygen Purity	Measure with purity meter	
	Ozone Manifolds	Cycle through all valves	
		Check for flow at all flowmeters	
Annually	Compressed Air and Oxygen Filters	Check/Replace	Kaeser F26KA: Replacement Filter
			Kaeser F26KB: Replacement Filter
			AF-12: Replacement Filter
			PR-8: Replacement Filter
	Check Valves	Test/Replace	CVST-6
			CVHP-6
	Leak Sensor	Replace	RME-1.0
			SM-EC

Oxygen Concentrator Maintenance

The Oxygen Concentrator sieve beds will require replacement after a minimum of 5 years. Replacement may be necessary earlier if operated in dirty or humid conditions, or if the compressed air supply contains oil or water.

NOTE: The Ozone Generator will produce less ozone and have erratic oxygen pressures when the sieve beds are nearing the end of their useful life.

APPENDIX D - TROUBLESHOOTING

Symptom	Possible Cause	Repair			
Low Ozone Concentration	Poor O2 Purity	See "Low 02 Purity"			
	Cells not operating at full power Change output percent value on main Screen				
	One or more cells disabled	Check status at manual operation screen			
	Overheating Cells	Check water chiller operation with manual for specific troubleshooting steps			
		Replace cooling water filter			
Low 02 Purity	Poor feed air quality	Check feed gas moisture content			
		Replace compressed air filters			
	Degraded Sieve Material	Replace sieve material			
	Plugged Orifice Plates	Remove and clean orifice plates in regeneration (if applicable) and purge lines			
Low 02 Flow	Plugged Orifice Plates	Remove and clean orifice plates in regeneration (if applicable) and purge lines			
	Leak	Use soapy water to find and repair leaks			
	Low Supply Pressure	Check pressure regulator setting			
		Replace incoming air filter			
		Check compressor operation			
Sieve bed dusting	Moisture in compressed air line	Check air dryer operation			
		Replace sieve material			
Ozone leak alarms	Leak in ozone lines	Use soapy water on fittings to find leaks and repair them			
Trailer temp high	Poor air conditioning	Check operation of air conditioners with air conditioner manuals for specific troubleshooting steps			
Low 02 PSI	Low supply pressure	Check pressure regulator setting			
		Replace compressed air and oxygen filters			
Low compressed air PSI	Old filters	Replace compressed air filters			
	Compressor issues	Check compressor manual for specific troubleshooting steps			

APPENDIX E - PERSONAL SAFETY AND EQUIPMENT DAMAGE CONCERNS

Flushing Ozone from the System

Safety warnings regarding ozone gas are found at the beginning of this manual, as well as in the ozone Safety Data Sheet. The RMT-1500 produces a large amount of ozone, which can be inadvertently "stored" within the Ozone Generators, manifolds, and ozone lines.

NOTE: In most circumstances, a very small amount of ozone will be contained within the system after shut-down and therefore exposure will be minimal.

Eventually the ozone (even while in the system) will safely revert back to oxygen, but in the right conditions the ozone can remain in the system for 24 hours or even longer. In the event that maintenance must be performed on the components in contact with ozone, the following is recommended for reducing the possibility of exposure to the ozone:

- Whenever possible it is recommended that the machine run with maximum permissible air and oxygen flow for at least 10 minutes with the Ozone Generator OFF in order to flush out most residual ozone.
- If the machine cannot be operated prior to maintenance or repair, a waiting period of 12 to 24 hours (if ozone has been produced recently) is recommended to allow the ozone to decay by reverting back into oxygen.

Isolating energy sources

The RMT-1500 has electrical and mechanical hazards, and maintenance or repair should not take place unless all energy sources have been turned off, disconnected, and/or drained.

APPENDIX F - SAFETY DATA SHEET

SAFETY DATA SHEET FOR OZONE

1. PRODUCT IDENTIFICATION PRODUCT NAME: Ozone COMMON NAME / SYNONYMS: Triatomic Oxygen, Trioxygen, O3 OZONE GENERATOR MANUFACTURER / SUPPLIER: Ozone Solutions 451 Black Forest Road / Hull, Iowa 51239 712.439.6880 / www.ozonesolutions.com / tinfo@ozonesolutions.com PRODUCT USE: This SDS is limited to ozone produced in gaseous form on site by an ozone generator, in varying concentrations, in either air or aqueous solutions, for the purposes of odor abatement, oxidation of organic compounds or antimicrobial intervention, in a variety of applications. 2. HAZARD IDENTIFICATION GHS CLASSIFICATIONS ENVIRONMENTAL PHYSICAL HEALTH Skin Irritation - Category 3 Eye Irritation - Category 2B Respiratory System Toxicity - Category 1 Oxidizing Gas Severe (Single & Repeated) WHMIS CLASSIFICATIONS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM, CANADA): C. D1A. D2A. D2B. F Source: CCOHS CHEMINFO Record Number 774 3. COMPOSITION CHEMICAL NAME Ozone COMMON NAMES Triatomic Oxygen, Trioxygen CHEMICAL FORMULA 0, 10028-15-6 CAS REGISTRY NUMBER 4. FIRST AID MEASURES ROUTE OF ENTRY SYMPTOMS FIRST AID Skin Contact Yes Irritation Rinse with Water Skin Absorption NA NA No Rinse with Water, Remove Irritation Eye Contact Yes Contacts Ingestion No NA NA Remove to Fresh Air, Headache, Cough, Heavy

 Ingestion
 NO
 NA
 NA

 Inhalation
 Yes
 Headache, Cough, Heavy Chest, Shortness of Breath
 Remove to Fresh Air, Provide Oxygen Therapy as Needed

 For severe cases, or if symptoms don't improve, seek medical help.
 Remove to Fresh Air, Provide Oxygen Therapy as

5. FIRE FIGHTING MEASURES

Ozone itself is not flammable. As a strong oxidant if may accelerate, even initiate, combustion or cause explosions. Use whatever extinguishing agents are indicated for the burning materials.

6. ACCIDENTAL RELEASE MEASURES

Turn off the ozone generator and ventilate the area. Evacuate until ozone levels subside to a safe level (<0.1 ppm).

7. HANDLING AND STORAGE

Ozone must be contained within ozone-resistant tubing and pipes from the generation point to the application point.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION						
OSHA PERMISSABLE EXPOSURE LIMIT	8 hour TWA 0.1 ppm					
ANSI / ASTM	8 hour TWA 0.1 ppm, STEL 0.3 ppm					
ACGIH	8 hour TWA 0.1 ppm, STEL 0.3 ppm					
NIOSH	ELCV 0.1 ppm Light: 0.8 ppm Moderate: 0.5 ppm Heavy; Light, Moderate, Heavy Work TWA <=2 Hours, 0.2 ppm Immediately Dangerous to Life or Health 5.0 ppm					
RESPIRATORY PROTECTION: Use full face self-contained breathing apparatus for entering areas with a high concentration of ozone.						
ENGINEERING CONTROL: Use ozone destruct unit for off gassing of ozone.						

9. PHYSICAL AND CHEMICAL PROPERTIES						
PHYSICAL STATE	Gas	рН	NA			
MOLECULAR WEIGHT	48.0	Decomposition Temperature	NA			
APPEARANCE	Clear at Low Concentration, Blue at Higher Concentration	Evaporation Rate	NA			
ODOR	Distinct Pungent Odor	Flash Point	NA			
ODOR THRESHOLD	0.02 to 0.05 ppm; Exposure Desensitizes	Auto-Ignition Temperature	NA			
MELTING POINT	-193°C/-315°F	Relative Density	NA			
BOILING POINT	-112°C/-169°F	Partition Coefficient	NA			
VAPOR PRESSURE	> 1 atm	Flammability	NA			
VAPOR DENSITY	1.6 (Air = 1)	Explosive Limits	NA			
SOLUBILITY IN WATER	570 mg / L at 20° C 100% 03; 0.64 at 0° C	Viscosity	NA			

10. STABILITY AND REACTIVITY

Ozone is highly unstable and highly reactive. Avoid contact with oxidizable substances. Ozone will readily react and spontaneously decompose under normal ambient temperatures.

11. TOXICOLOGY INFORMATION						
ROUTES OF EXPOSURE	Inhalation, Eyes, Skin Exposure					
EFFECTS OF ACUTE EXPOSURE	Discomfort; including headache, coughing, dry throat, shortness of breath, pulmonary edema; higher levels of exposure intensify symptoms. Possible irritation of skin and / or eyes.					
EFFECTS OF CHRONIC EXPOSURE	Similar to Acute Exposure effects, with possible development of schronic breathing disorders, including asthma.					
LC ₅₀	Mice 12.6 ppm for 3 hrs / Hamsters 35.5 ppm for 3 hrs					
IRRITANCY OF OZONE	Yes					
SENSITIZATION TO OZONE	No					
CARCINOGENICITY (NTP, IARC, OSHA)	No					
REPRODUCTIVE TOXICITY, TERATOGENICITY, MUTAGENICITY	Not Proven					
TOXICOLOGICALLY SYNERGISTIC PRODUCTS	Increased susceptibility to allergens, pathogens and irritants					

12. ECOLOGICAL INFORMATION

The immediate surrounding area may be adversely affected by an ozone release, particularly plant life. Discharge of ozone in water solution may be harmful to aquatic life. Due to natural decomposition, bioaccumulation will not occur and the area affected will be limited.

13. DISPOSAL CONSIDERATIONS

Off-gassing of ozone should be through an ozone destruct unit which breaks ozone down to oxygen before release into the atmosphere.

14. TRANSPORT INFORMATION

NOT APPLICABLE, as ozone is unstable and either reacts or decomposes and must be generated at the location and time of use.

15. REGULATORY INFORMATION (Source: EPA List of Lists)					
SARA TITLE III SECTION 302 EHS TPQ	100 lbs				
SARA TITLE III SECTION 304 EHS RQ	100 lbs				
SARA TITLE III SECTION 313	> 10,000 lbs used / year				

16. OTHER INFORMATION

Half-life of ozone in water at 20 ° C = 20 minutes; in dry still air at 24 ° C = 25 hour; decreases significantly with increase in humidity, presence of contaminants, air movement and / or increase in temperature.

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