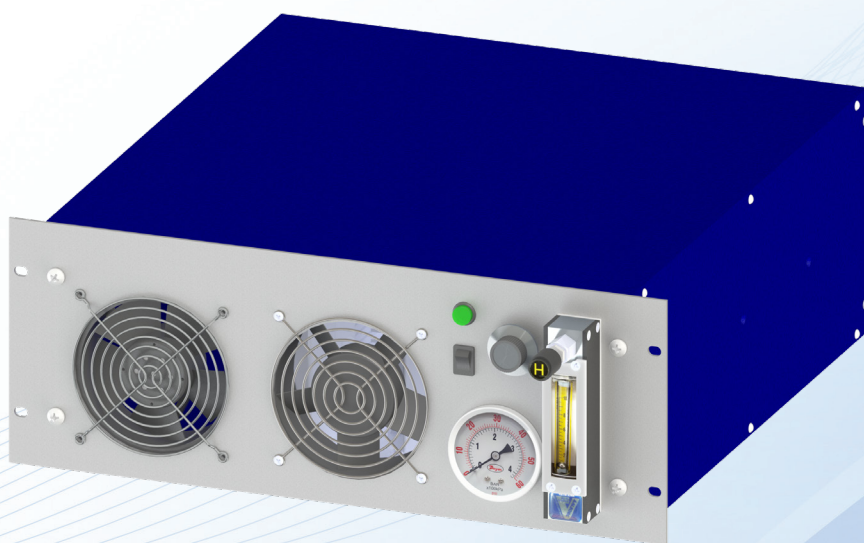


TG SERIES

AIR COOLED OZONE GENERATOR

MODEL: TG-10, 20, 40

INSTALLATION & OPERATIONS MANUAL



451 Black Forest Road / Hull, Iowa 51239 USA
P 712.439.6880 / F 712.439.6733

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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:

1. 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 tubing connections between the Ozone Generator and the injection point are secure and in good working condition. Failure to do so could result in the discharge of ozone into an undesired space.

THEORY OF OPERATION

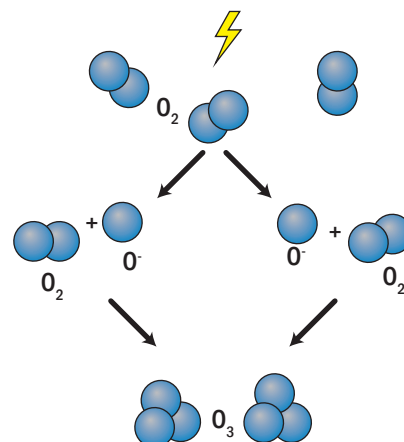
The Ozone Generator produces ozone by using the corona discharge method. This process uses an electrical spark to split the molecular bond of natural diatomic oxygen, converting it into atomic O⁻ atoms. These O⁻ atoms bond to other O₂ molecules to form O₃ (ozone).

The electrical spark, used to split the molecular bonds, happens in a controlled electrical field inside the corona cell. This spark is produced by forcing a high voltage through a dielectric and a small air gap where the feed gas flows through. The spark occurs at extremely high voltages and frequencies, which are increased and regulated by the onboard electronics in the machine.

The basic fundamentals of flow and velocity of gas through the corona cell allow for more ozone production (g/hr.) as oxygen flow increases. As the flow increases, the concentration of ozone (% by weight) decreases. Conversely, as the flow decreases, the concentration of ozone increases. At very low oxygen flow rates, the oxygen remains in the corona cell for a longer period of time.

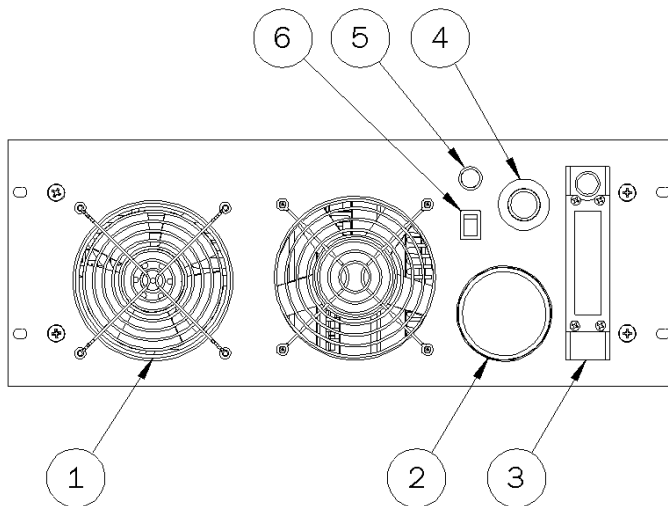
The contact time (CT value) allows a higher percentage of oxygen to be converted into ozone. The ozone production and concentration of the TG ozone machine can be determined using the performance charts in this manual.

While the flow rate of the oxygen feed gas affects the ozone output the most, the pressure of the feed gas also effects the ozone output. Higher pressures create higher concentrations of the feed gas which result in a higher ozone concentration. If the feed gas flow rate remains the same while under a higher pressure, it allows an increased CT value. With increased feed gas pressures, additional electrical power is needed to create a spark in the pressurized corona cell. The electronics in this machine automatically compensate for the varying pressure to maximize the ozone output. While increased feed gas pressure helps achieve a higher output, it also forces the created ozone molecules back into oxygen at a quicker rate.



SECTION 2

COMPONENT DIAGRAM



COMPONENT DESCRIPTIONS

1. Intake Fans: Provide air flow to unit for cooling.
2. Pressure Gauge: Indicates the amount of pressure on the ozone cell.
3. Flow Meter: Indicates the amount of ozone flowing from the cell.
4. Potentiometer: Increases or decreases the ozone output production.
5. Ozone Light: Indicates if the inverter board is on and producing ozone.
6. ON/OFF Switch: Turns the unit on and off.

INSTALLATION REQUIREMENTS

This ozone generator is not weather proof; therefore, a non-condensing, dust-free, indoor environment is required for operation.

Ambient Temp

For best performance, the operating temperature should be between 40°F and 95°F, and the storage temperature should be between -20°F and 170°F.

Ventilation

Approximately three air changes per hour are recommended. Proper ventilation helps prevent the accumulation of ozone in the event of a leak.

Clear Space

Maintain 12-24 inches of clear space around the machine to allow proper ventilation and maintenance service work to be performed.

Power source

Connect the machine to a grounded power source that is rated for the required electric current and voltage.

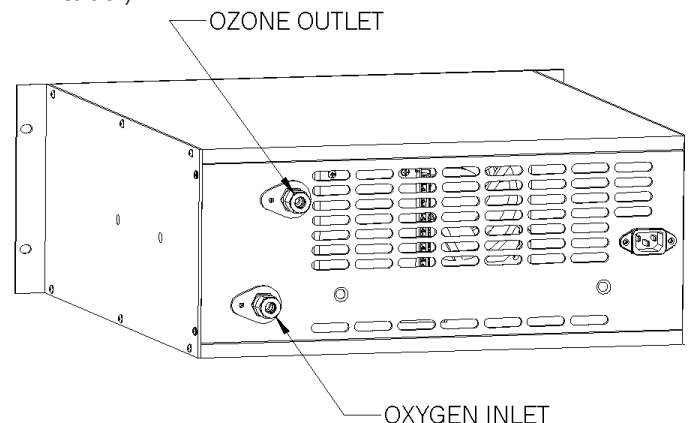
Pressure

Maximum ozone production is realized at 10-20 PSI of pressure. Pressures up to 100 PSI are acceptable, but will not result in maximum ozone production. If pressures will reach higher than 45 PSI, the generator must be tuned and the transformer replaced to maximize the efficiency of the machine. Please contact Ozone Solutions for information regarding this process.

The Ozone Generator will not operate under a vacuum and must have at least 1 PSI of pressure for ozone production. Below 1 PSI, the cell will produce no ozone and may suffer damage.

MECHANICAL INSTALLATION

1. Connect to the oxygen inlet and ozone outlet fittings using stainless steel, teflon, or other high-quality ozone-resistant tubing .
2. With an open ended wrench, tighten the compression fitting nuts, as needed. A minimum of 1 1/4 turn is recommended. (Note: The stainless steel ferrules will become part of the tubing, because they will no longer move freely along the tube.)



SPECIFICATIONS

MODEL NUMBER	OZONE PRODUCTION (G/HR)	FLOW RATE (LPM)	GAS CONNECTIONS (INCHES)	POWER SUPPLY (VOLTS A/C)	POWER CONSUMPTION (WATTS)	CURRENT (AMPS)	DIMENSIONS (D X W X H)	WEIGHT (LBS)
TG-10	10	0-10	1/4 Tube	110 Single Phase	150	3	23 x 17 x 7	23
TG-20	20	0-10	1/4 Tube	110 Single Phase	300	3	23 x 17 x 7	23
TG-40	40	0-10	3/8 Tube	110 Single Phase	400	5	23 x 17 x 7	32

SECTION 3

SYSTEM OPERATION

1. Insure oxygen is flowing through the unit before beginning the initial start-up process.
2. Set the flow and pressure as desired for operation. Adjust the oxygen feed rate, and pressure as needed within the capacity of the Ozone Generator. Refer to the Ozone Generator performance charts for guidance.
3. Confirm that all connections from the machine to the application are secure. Spray the connections with soapy water. Bubbles or hissing indicate a leak and require correction. Emitted ozone gas can be harmful to personnel and other equipment.
4. To start the Ozone Generator, turn the switch on the front panel of the generator to "on." A solid, green status light will illuminate to indicate ozone production.
5. Adjust ozone output as needed using the 10 position knob. The potentiometer electrical value can be adjusted from 0-100% using a knob. This reading is not perfectly linear, therefore an ozone analyzer is recommended for accurate ozone output.

REMOTE OPERATION

The TG Series can be turned on or off remotely, and the output of the unit can be adjusted from 0-100% using a 0-10V or 4-20mA input.

The use and type of the remote control must be qualified prior to implementation, so please contact Ozone Solutions for more information before installing a remote for your unit.

TROUBLESHOOTING

While the Ozone Generator is in operation, the green status light will remain lit to indicate that the inverter is on, power is being sent to the transformer, and ozone is being generated. Additionally, fans will run in order to cool the unit throughout the time that it is on. This light is also responsible for indicating proper operation of the inverter. Different light operating conditions for various models are as follows:

For TG-10 and TG-20 models,

SOLID: Active, producing ozone

BLINKING: N/A

OFF: Inactive, system not powered, inverter off or malfunctioning

For TG-40 model,

SOLID: Active, producing ozone

BLINKING light*: Standby mode, ozone is not being produced

OFF Inactive, system not powered, inverter off or malfunctioning

**If the TG-40 status light is blinking, adjust the potentiometer to begin producing ozone.*

SECTION 4

WARRANTY

Ozone Solutions warrants all new 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 contact Ozone Solutions at 712.439.6880 or 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.

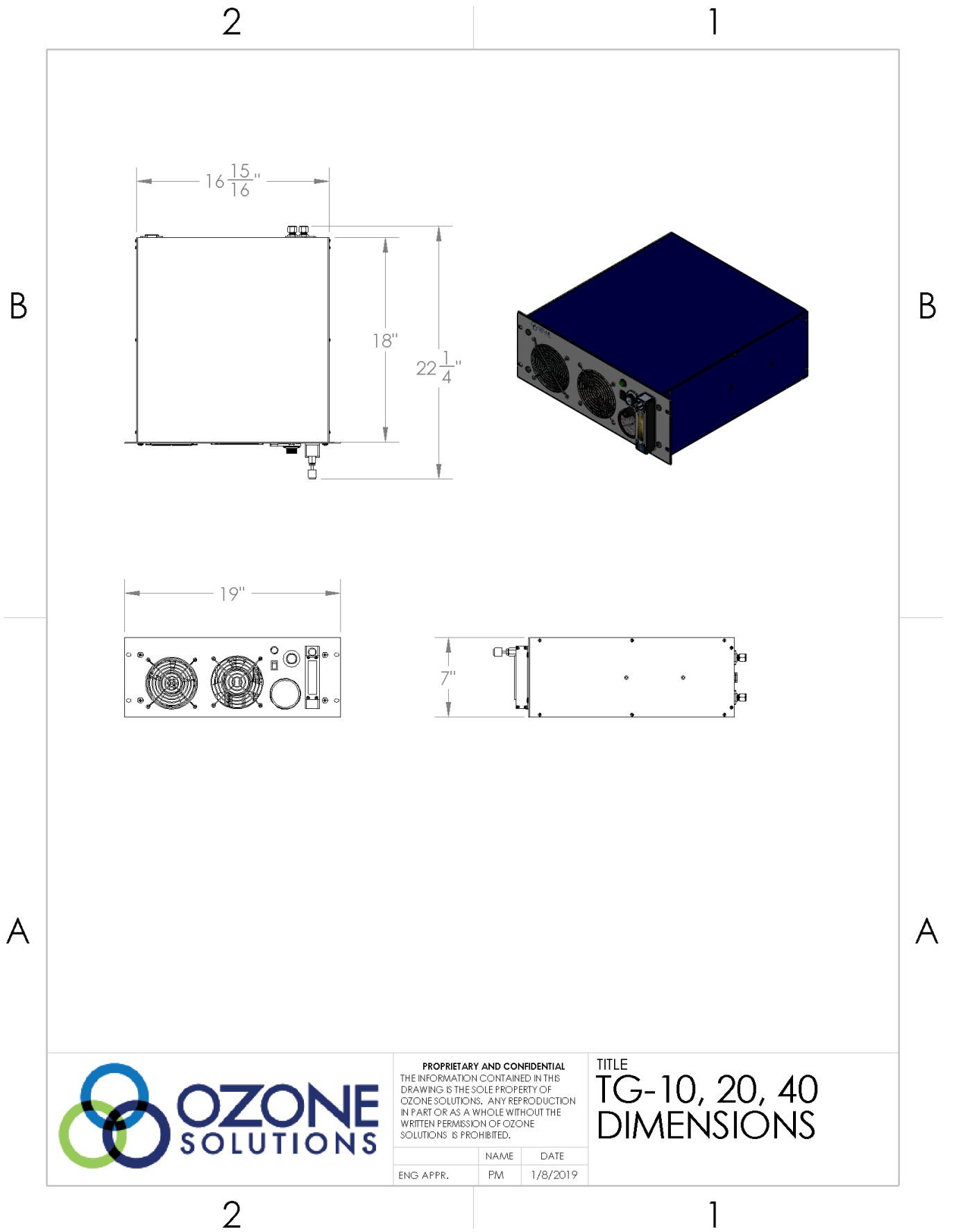
Ozone Solutions reserves the right to make changes in its products without notice. Because of this, Ozone Solutions is not obligated to replace warranty defective part (s) and/or product with the same original part or product.

CONTACT INFORMATION

Ozone Solutions, Inc.
451 Black Forest Road
Hull, IA 51239 USA

Phone:	712.439.6880
Fax:	712.439.6733
Email:	sales@ozonesolutions.com
Website:	www.ozonesolutions.com

APPENDIX A - CAD DRAWING



Flowmeter "Corrected Flow" Chart

Example #1:

At **10** PSI, and the flowmeter reads **5**, your "Corrected Flow" will be **6.5**

PSI

FLOW

	3	4	6	8	10	12	16	20	25	30	35	40
1	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.5	1.6	1.7	1.8	1.9
2	2.2	2.3	2.4	2.5	2.6	2.7	2.9	3.1	3.3	3.5	3.7	3.9
3	3.3	3.4	3.6	3.7	3.9	4.0	4.3	4.6	4.9	5.2	5.5	5.8
4	4.4	4.5	4.7	5.0	5.2	5.4	5.8	6.1	6.6	7.0	7.4	7.7
5	5.5	5.6	5.9	6.2	6.5	6.7	7.2	7.7	8.2	8.7	9.2	9.6
7	7.7	7.9	8.3	8.7	9.1	9.4	10.1	10.8	11.5	12.2	12.9	13.5
9	9.9	10.2	10.7	11.2	11.7	12.1	13.0	13.8	14.8	15.7	16.5	17.4
11	12.1	12.4	13.1	13.7	14.3	14.8	15.9	16.9	18.1	19.2	20.2	21.2
13	14.3	14.7	15.4	16.2	16.9	17.5	18.8	20.0	21.4	22.7	23.9	25.1
15	16.5	16.9	17.8	18.6	19.4	20.2	21.7	23.0	24.7	26.2	27.6	28.9
17	18.7	19.2	20.2	21.1	22.0	22.9	24.6	26.1	27.9	29.6	31.3	32.8
19	20.8	21.4	22.5	23.6	24.6	25.6	27.5	29.2	31.2	33.1	34.9	36.7
21	23.0	23.7	24.9	26.1	27.2	28.3	30.3	32.3	34.5	36.6	38.6	40.5
23	25.2	25.9	27.3	28.6	29.8	31.0	33.2	35.3	37.8	40.1	42.3	44.4
25	27.4	28.2	29.7	31.1	32.4	33.7	36.1	38.4	41.1	43.6	46.0	48.2
27	29.6	30.5	32.0	33.6	35.0	36.4	39.0	41.5	44.4	47.1	49.6	52.1
29	31.8	32.7	34.4	36.0	37.6	39.1	41.9	44.6	47.7	50.6	53.3	55.9
31	34.0	35.0	36.8	38.5	40.2	41.8	44.8	47.6	50.9	54.1	57.0	59.8
33	36.2	37.2	39.2	41.0	42.8	44.5	47.7	50.7	54.2	57.5	60.7	63.7
35	38.4	39.5	41.5	43.5	45.4	47.2	50.6	53.8	57.5	61.0	64.4	67.5
37	40.6	41.7	43.9	46.0	48.0	49.9	53.5	56.8	60.8	64.5	68.0	71.4
39	42.8	44.0	46.3	48.5	50.6	52.6	56.4	59.9	64.1	68.0	71.7	75.2
41	45.0	46.2	48.7	50.9	53.1	55.3	59.3	63.0	67.4	71.5	75.4	79.1
43	47.2	48.5	51.0	53.4	55.7	58.0	62.1	66.1	70.7	75.0	79.1	82.9
45	49.4	50.8	53.4	55.9	58.3	60.6	65.0	69.1	74.0	78.5	82.7	86.8

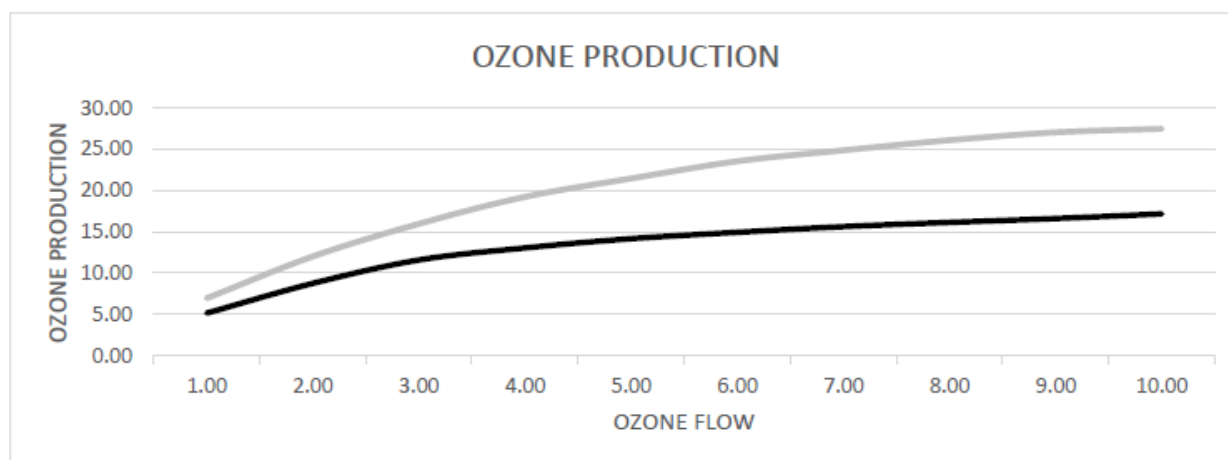
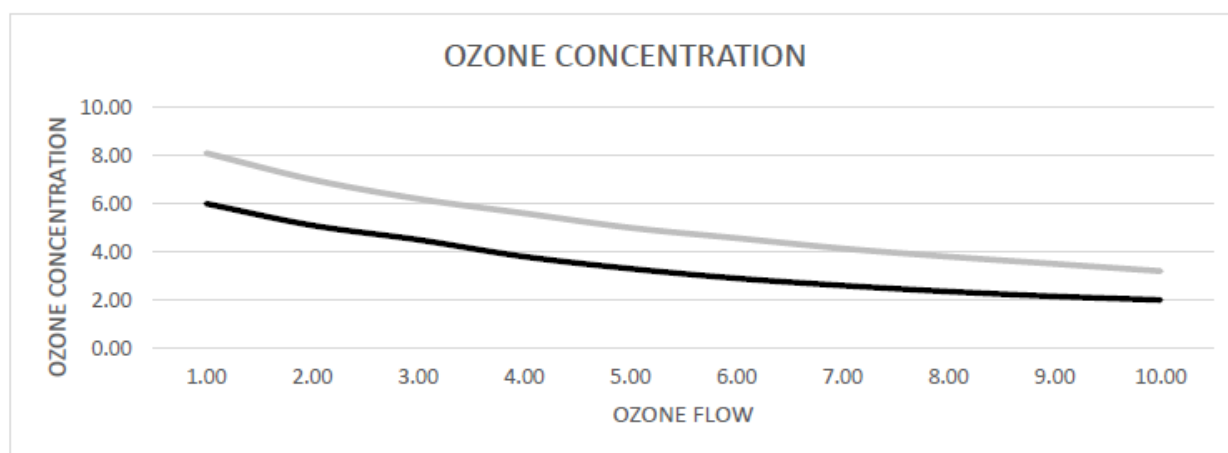
APPENDIX C - PERFORMANCE CHARTS

OZONE GENERATOR PERFORMANCE TEST



TG SERIES OZONE GENERATORS

Ozone Flow (lpm)	PSI	Ozone Concentration (% by weight)		Ozone Production (g/hr)	
		TG-20	TG-10	TG-20	TG-10
1.00	10	8.10	6.00	6.95	5.15
2.00	10	7.00	5.10	12.01	8.75
3.00	10	6.20	4.50	15.96	11.58
4.00	10	5.60	3.80	19.22	13.04
5.00	10	5.00	3.30	21.45	14.16
6.00	10	4.57	2.90	23.53	14.93
7.00	10	4.14	2.60	24.86	15.62
8.00	10	3.80	2.35	26.08	16.13
9.00	10	3.50	2.15	27.03	16.60
10.00	10	3.20	2.00	27.46	17.16



Test was performed at 72°F, running for over an hour.

Additional Equipment: Ozone Analyzer API 454

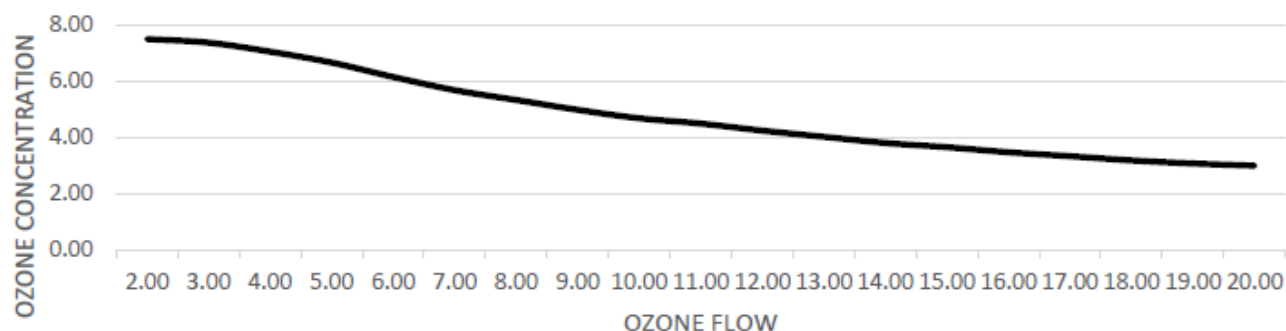
OZONE GENERATOR PERFORMANCE TEST



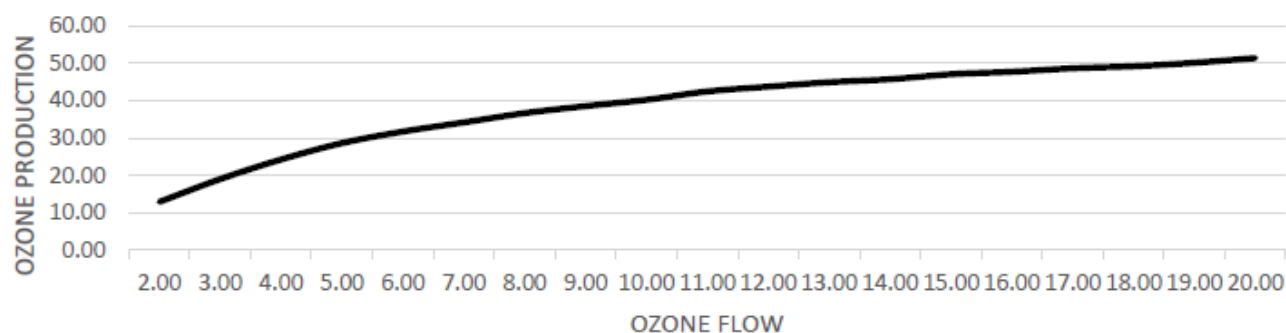
TG SERIES OZONE GENERATORS

		Ozone Concentration (% by weight)	Ozone Production (g/hr)
Ozone Flow (lpm)	PSI	TG-40	TG-40
2.00	10	7.50	12.87
3.00	10	7.37	18.97
4.00	10	7.05	24.20
5.00	10	6.66	28.57
6.00	10	6.15	31.66
7.00	10	5.68	34.11
8.00	10	5.33	36.59
9.00	10	4.98	38.46
10.00	10	4.68	40.15
11.00	10	4.49	42.38
12.00	10	4.24	43.66
13.00	10	4.02	44.84
14.00	10	3.80	45.65
15.00	10	3.65	46.98
16.00	10	3.47	47.64
17.00	10	3.33	48.57
18.00	10	3.18	49.11
19.00	10	3.07	50.05
20.00	10	2.99	51.31

OZONE CONCENTRATION



OZONE PRODUCTION



Test was performed at 72°F, running for over an hour.

Additional Equipment: Ozone Analyzer API 454

APPENDIX D - MAINTENANCE

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

Maintenance Table

COMPONENT	ACTION	TIME INTERVAL	PART NUMBER(S)
Flow Meter with Needle Valve	Replace the O-Rings	2 Years	FM-6 Service Kit

APPENDIX E - SAFETY DATA SHEET



SAFETY DATA SHEET FOR OZONE FORMERLY MSDS

1. PRODUCT IDENTIFICATION			
PRODUCT NAME: Ozone			
COMMON NAME / SYNONYMS: Triatomic Oxygen, Trioxigen, 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			
PHYSICAL		HEALTH	ENVIRONMENTAL
Oxidizing Gas	Skin Irritation - Category 3 Eye Irritation - Category 2B Respiratory System Toxicity - Category 1 (Single & Repeated)		Severe
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, Trioxigen	
CHEMICAL FORMULA		O ₃	
CAS REGISTRY NUMBER		10028-15-6	
4. FIRST AID MEASURES			
ROUTE OF ENTRY		SYMPTOMS	FIRST AID
Skin Contact	Yes	Irritation	Rinse with Water
Skin Absorption	No	NA	NA
Eye Contact	Yes	Irritation	Rinse with Water, Remove Contacts
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.			
5. FIRE FIGHTING MEASURES			
Ozone itself is not flammable. As a strong oxidant it 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 PERMISSIBLE 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	pH	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% O3; 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.			
Preparer: Tim McConnel and Stacey Eben, Ozone Solutions 5/1/2012 (layout revision (2/13/2018))			

DISCLAIMER: Ozone Solutions provides this information in good faith, but makes no claim as to its comprehensiveness or accuracy. It is intended solely as a guide for the safe handling of the product by properly trained personnel, and makes no representations or warranties, express or implied, of the merchantability or fitness of the product for any purpose, and Ozone Solutions will be responsible for any damages resulting from the use of, or reliance upon, this information.



OZONE SOLUTIONS

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Rev 2a

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