# Standard Operating Procedure

## Ozone and Ozone Generator

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|---|---|
| **Department:** | Chemistry |
| **Date SOP was written:** | 1/14/2014 |
| **Date SOP was approved by PI/lab supervisor:** | Click here to enter a date. |
| **Principal Investigator:** | Click here to enter text. |
| **Internal Lab Safety Coordinator/Lab Manager:** | Joel Gillespie; jrg68@pitt.edu |
| **Lab Phone:** | 4-0312 |
| **Office Phone:** | 4-0312 |
| **Emergency Contact:** | 412-624-2121 (Pitt Police) |
| **Location(s) covered by this SOP:** | CHVRN 1115 |

**Type of SOP:** X Process X Hazardous Chemical X Hazardous Class

### Purpose

Manual and Safe Operating Instructions for the use of the Departmental Welsbach T-Series Ozone Generator

### Physical & Chemical Properties/Definition of Chemical Group

CAS#: 10028-15-6.

Class: Powerful oxidizer

Molecular Formula: $O_3$

Form (physical state): Gas; about 1.5x heavier than air

Color: Blue; colorless at low concentrations in other solvents

Boiling point: – 111.9 °C

## Potential Hazards/Toxicity

Irritation eyes, mucous membrane; pulmonary edema; chronic resp disease; IDLH 5 ppm.

• Oxygen is a fire hazard. It is very dangerous and vigorously accelerates the burning of combustible materials. To avoid fire and/or explosion, never use oil, grease, cotton fibers, or any other combustible material on or near the ozone generator. It is STRONGLY recommended that only individuals experienced in the safe handling of oxygen be allowed to operate this equipment.

• OSHA exposure limit for ozone is 0.1 ppm for a period of 8 h. (Ref. OSHA Air Contaminants Standard, 29 CFR 1910.1000).

• Ozone is a highly toxic oxidizer. Ozone has a distinctive, pungent odor, which is easily recognized at very low concentrations. If this odor presents itself at any level, disconnect the generator and alert the emergency contact.

• High voltage and high capacitance is present in ozone generators. Only qualified electricians should work on this equipment. Ozone cannot be stored or transported in vessels because it decomposes spontaneously in the presence of oxidizable impurities, humidity and solid surfaces. The rate of decomposition increases with temperature.

## Personal Protective Equipment (PPE)

BEFORE working with unfamiliar chemical reagents, read the relevant Safety Data Sheets (SDS) and understand the hazards. Discuss the instrument and the experiment with the appropriate, trained personnel in your group and your Department. Request training and obtain permission to use the instrument by the instrument supervisor. Set up your work in a laboratory fume hood or glove box and ALWAYS wear the appropriate PPE. Never work alone.

### Eye Protection

• Chemical splash goggles or safety glasses that meet the ANSI Z.87.1 1989 standard must be worn whenever handling chemicals. Ordinary prescription glasses will NOT provide adequate protection unless they also meet this standard. When there is the potential for splashes, goggles must be worn, and when appropriate, a face shield added.

### Skin Protection

• Gloves should be worn when handling chemicals. Nitrile gloves are adequate for handling many chemicals, but they are combustible. Use adequate protection to prevent skin exposures. Heavy gloves are required for work with large quantities.
• *A fire resistant lab coat must be worn*.
• A chemical-resistant apron worn over the lab coat is required for working with large quantities.
• Long pants should be worn.
• No open toe shoes are allowed.

## First Aid Procedures

Medical attention; fresh air, 100% oxygen

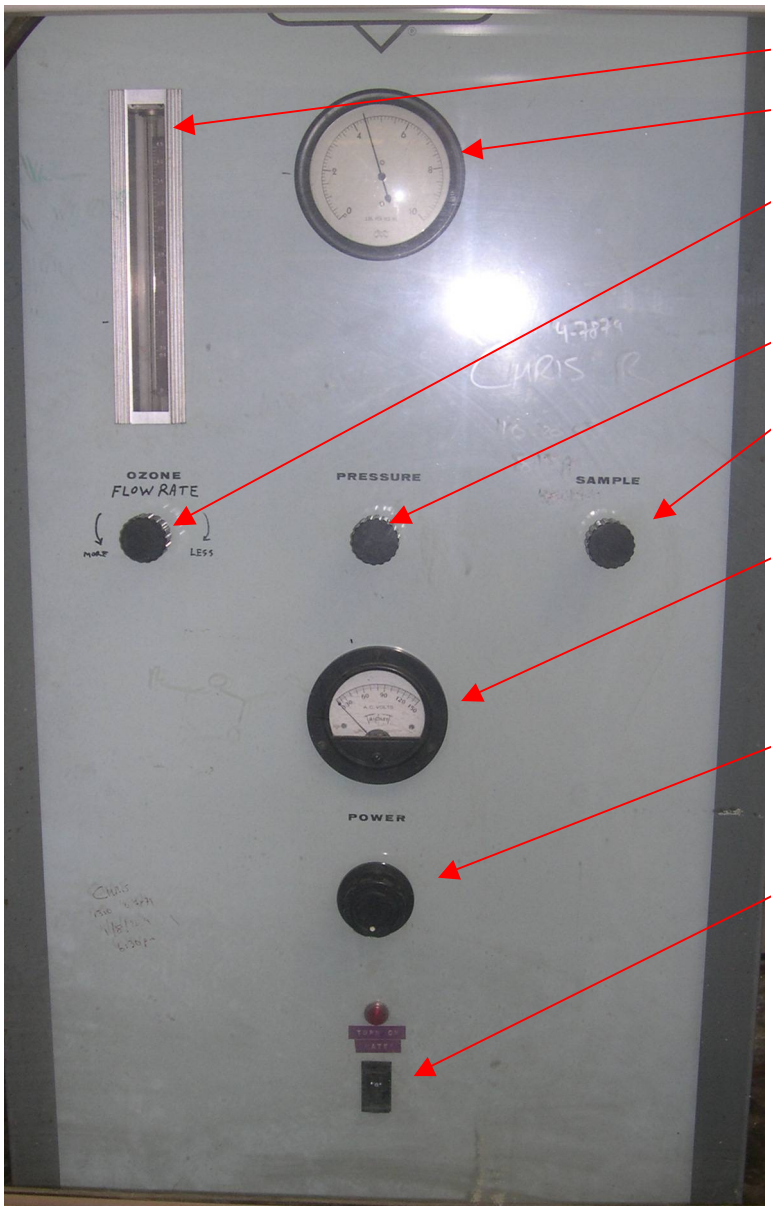
## Medical Emergency Dial 412-624-2121

## Protocol/Procedure Using the Welsbach T-Series Ozone Generator

The Welsbach T-series ozone generator produces ozone ($O_3$) by generating a coronal discharge between two plates with a constant flow of oxygen ($O_2$) between them. The amount of ozone generated is directly proportional to the voltage across the flow channel with high voltages generating more ozone. Any materials coming in contact with the ozone must be resistant to oxidation or they will be corroded. Glass and Tygon tubing are the preferred materials for delivering the ozone from the generator to your reaction flask.

Warning and Cautions:

1.) Training is required to use this and all departmental equipment. Use of this equipment without proper training is hazardous to the user and the instrument and may result in serious personal injury or damage to the equipment.
2.) The ozone generator is using a high voltage electrical discharge to ionize oxygen into ozone. The discharge is of significant current to present a lethal shock hazard and may physically damage the instrument if used inappropriately. The electrical potential in present once the instrument is energized even if the power switch is off and the electrical plug disconnected. For this reason attempting to access the interior of the instrument for any reason is strictly forbidden.
3.) Ozone is a carcinogen. Exposure to the ozone generated by the instrument should be avoided. Use the instrument only in the fume hood. Vent the lines after usage, making sure all discharge is vented into the fume hood.
4.) IMPORTANT: If the instrument is unlikely to be used for a week or more, the cooling water lines must be emptied of water. Failure to do this will result in the build-up of particulates and other contaminants on the dielectric chamber, resulting in high voltage breakdown (arcing) and destruction of the chamber itself.




a.) Ozone flow meter

b.) Pressure Gauge

c.) Ozone flow control

d.) Pressure

e.) Sample

f.) Voltage meter

g.) Voltage control

h.) On/Off switch

Cooling water control (not shown)

**Start Up**

1.) Sign into the log book, adding your cell number so that you can be reached in case of an emergency. Ensure the power switch is in the “OFF” position.
2.) Turn on the cooling water supply underneath the hood sash.
3.) Turn on the oxygen cylinder control to begin flowing oxygen into the instrument. Allow oxygen to flow for approximately 10 min to flush out any residual volatile substances.
4.) Adjust the ozone flow control (c) to the desired flow level as indicated on the ozone flow meter (b).
5.) Adjust the pressure regulating valve (d) to read 8 PSI on the Ozone shell pressure gauge (b). **Do not exceed 12 PSI**. Note that the inlet pressure and ozone pressure are interrelated and you may need to readjust the ozone flow after adjusting the pressure and vice versa.

6.) Rotate the voltage adjustment knob (g) fully counterclockwise to set the voltage to the minimum value.

**Operation**

1.) Turn on the On/Off switch (h).
2.) Open the sample valve (e).
3.) Slowly rotate the voltage adjustment knob (g) clockwise to increase the voltage and generate ozone. Note that ozone is generally not produced below approximately 60 Volts.

**Shut Down**

1.) After use of the instrument is complete, turn the voltage adjustment (g) fully counterclockwise to minimize the input voltage.
2.) Turn the power switch to the “OFF” position.
3.) Continue to purge the system with oxygen for an additional 30 min to remove residual ozone from the instrument. Failure to perform this step can damage the instrument and is hazardous to other laboratory workers.
4.) Close the oxygen feed gas.
5.) Close the cooling water supply.
6.) Completely close the ozone outlet value (c) and the ozone sample valve (e) to prevent backwash of air into the system.
7.) If the instrument is not going to be used for an extended period of time (a week or more), the cooling water must be bled from the water lines to prevent corrosion and fouling.
8.) Sign off on the log book and add any comments, if necessary.

**NOTE**

Any deviation from this SOP requires approval from PI.

**Documentation of Training** (signature of all users is required)

- Prior to conducting any work with ozone and/or the Welsbach ozone generator, designated personnel must provide training to his/her laboratory personnel specific to the hazards involved in working with this substance and instrumentation, work area decontamination, and emergency procedures.
- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the ozone SDS.
- The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate laboratory safety training or refresher training within the last one year.

I have read and understand the content of this SOP:

| Name | Signature | Date |
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