

### GENERAL PROPERTIES OF OZONE

Ozone (O<sub>3</sub>) is the triatomic, allotropic form of oxygen (O<sub>2</sub>). It is an unstable gas with a pungent odor. Since ozone is unstable, it must be generated at the point of application. The Ozone molecule, having a molecular weight of 48, is made up of three oxygen atoms bound by equal oxygen-oxygen bonds at an obtuse angle of 116°49'. This structure is inherently unstable and is the reason for ozone's powerful oxidizing ability. Ozone has approximately 150% the oxidizing potential of chlorine. The physical properties of ozone and comparative oxidizing potentials for other chemical oxidants are presented in Table 1 and Table 2, respectively.

Table 1 Physical Constants of Ozone	
Molecular weight, g/g-mol	48.0
Boiling point, °C	-111.9
Melting point, °C	-193
Gas density, 0°C grams/liter	2.144
Critical temperature, °C	-12.1
Critical pressure, atm.	54.6
Critical volume, cc/mol	147.1

Table 2 Comparative Oxidizing Potentials 25°C	
	Volts
Fluorine (F <sub>2</sub> )	2.87
Ozone (O <sub>3</sub> )	2.08
Hydrogen Peroxide (H <sub>2</sub> O <sub>2</sub> )	1.78
Potassium Permanganate (KMnO <sub>4</sub> )	1.70
Hyprobromous Acid (HOBr)	1.59
Hypochlorous Acid (HOCl)	1.49
Chlorine (Cl <sub>2</sub> )	1.36
Oxygen (O <sub>2</sub> )	1.23
Bromine (Br <sub>2</sub> )	1.09
Chlorine Dioxide (ClO <sub>2</sub> )	.95

Water Quality Association Ozone task force. 1997. A reference manual Water Quality Association. Lisle, IL, 2- 4.

### HEALTH EFFECTS OF OZONE

	Concentration ppm	Duration Of Exposure	Effects
ACCEPTABLE ZONE	0.01 - 0.04	-	Odor threshold
	0.1	-	Minor eye and throat irritation
	0.1	8 Hour Average	Exposure limit
HAZARDOUS ZONE	>0,1	Few minutes	Continuous headache, shortness of breath
	0.25 - 0.5	2 - 5 Hours	Reduction in lung function and the ability to do physical work (for persons with a history of heart or lung disease)
	0.3	15 minute	exposure limit
	0.4	2 Hours	Reduction in lung capacity during moderate work for all persons
	>0.6	1 - 2 Hours	Chest pain, dry cough
	1.0	1 - 2 Hours	Lung irritation (coughing), sever fatigue
	>1.5	2 Hours	Reduced ability to think clearly. Continuing cough and extreme tiredness maybe lasting for 2 weeks. Sever lung irritation with fluid.
CRITICAL ZONE	9	Intermittent	Sever pneumonia ( arc welding)
	10	Immediately	dangerous to life and health
	11	15 minutes	Rapid unconsciousness
	50	30 minutes	Expected to be fatal

## UNIFORM FIRE CODE - 2003 EDITION

### APPENDIX II-I OZONE GAS-GENERATING EQUIPMENT

#### SECTION 1 - SCOPE

Equipment having a maximum ozone-generating capacity of 1/2 lb (0.23 kg) or more over a 24-hour period shall be in accordance with this appendix. Exception: Ozone-generating equipment used in one and two family dwellings and lodging and rooming house occupancies.

#### SECTION 2 - DEFINITIONS

For the purpose of Appendix II-I, certain terms are defined as follows: OZONE GENERATOR is equipment which causes the production of ozone.

#### SECTION 3 - STANDARDS

The following standard is intended for use as a guide in the design, fabrication, testing and use of equipment regulated by Appendix II-I: Standard 250, Enclosures for Electrical Equipment, National Electric Manufacturers Association, 2101 L Street, N.W. Suite 300, Washington, DC 20037.

#### SECTION 4 - LOCATION

**4.1 General.** Ozone generators shall be located in approved cabinets or ozone-generator rooms in accordance with Section 4. EXCEPTION: A generator within an approved pressure vessel need not be in a cabinet or ozone-generator room when located outside of buildings.

**4.2 Cabinets.** Ozone cabinets shall be constructed of approved materials compatible with ozone in accordance with nationally recognized standards. Cabinets shall display an approved sign stating, OZONE GAS GENERATOR - HIGHLY TOXIC - OXIDIZER, See Section 3.

Cabinets shall be braced for seismic activity in accordance with the Building Code.

Cabinets shall be mechanically ventilated with a minimum of six air changes per hour. Exhausted air shall be directed to a treatment system designed to reduce the discharge concentration of the gas to one half of the IDLH value at the point of discharge to the atmosphere.

The average velocity of ventilation at makeup air openings with cabinet doors closed shall not be less than 200ft per minute (1.02 m/s).

**4.3 Ozone-generator Rooms.** Ozone-generator rooms shall be mechanically ventilated with a minimum of six air changes per hour. Exhausted air shall be directed to a treatment system designed to reduce the discharge concentration of gas to one half of the IDLH value at the point of discharge to the atmosphere or ozone-generator rooms shall be equipped with a continuous gas detection system which will shut off the generator and sound a local alarm when concentrations above the permissible exposure limit occur.

Ozone-generator rooms shall not be normally occupied, and such rooms shall be kept free of combustible and hazardous material storage. Room access doors shall display an approved sign stating: OZONE GAS GENERATOR - HIGHLY TOXIC - OXIDIZER.

#### SECTION 5 - PIPING VALVES AND FITTINGS

**5.1 General.** Piping, valves, fittings and related components used to convey ozone shall be in accordance with Section 5.

**5.2 Secondary Containment.** Secondary containment, such as double-walled piping or exhausted enclosures, shall be provided for piping, valves, fittings and related components. Secondary containment shall be capable of directing a sudden release to an approved treatment system. Exception: Welded stainless steel piping and tubing.

**5.3 Materials.** Materials shall be compatible with ozone and shall be rated for the design operating pressures.

**5.4 Identification.** Piping shall be identified "Ozone Gas - Highly Toxic - Oxidizer."

#### SECTION 6 - AUTOMATIC SHUTDOWN

Ozone generators shall be designed to automatically shut down under the following conditions:

- (1) When the dissolved ozone concentration in the water being treated is above saturation when measured at the point where the water is exposed to the atmosphere,
- (2) When the process using generated ozone is shut down,
- (3) Failure of the ventilation system for the cabinet or ozone generator room, or
- (4) Failure of the gas detection system.

#### SECTION 7 - MANUAL SHUTDOWN

Manual shutdown controls shall be provided at the generator and, if in a room, within 10 ft (3 m) of the main exit or exit-access door.