



Independent Comments On Ozone

| | Page # |
|--------------------------------------------------------------------|----------------|
| US EPA Opinion on Ozone Generators | 2 – 7 |
| Consumer Report on Use of Ozone | 8 |
| OSHA Comments on Permissible Exposure Limits To Ozone | 9 |
| OSHA Comment on Use of Ozone Indoors | 10 - 11 |
| EPA Fact Sheet on Ground Level Ozone | 12 – 14 |
| American Lung Association (WA) Comments on Ozone Generators | 15 |



OZONE GENERATORS THAT ARE SOLD AS AIR CLEANERS: *An Assessment of Effectiveness and Health Consequences*

Note: There is a large body of written material on ozone and the use of ozone indoors. However, much of this material makes claims or draws conclusions without substantiation and sound science. In developing ***Ozone Generators that are Sold as Air Cleaners***, the EPA reviewed a wide assortment of this literature, including information provided by a leading manufacturer of ozone generating devices. In keeping with EPA's policy of insuring that the information it provides is based on sound science, only peer reviewed, scientifically supported findings and conclusions were relied upon in developing this document.

Introduction and Purpose

Ozone generators that are sold as air cleaners intentionally produce the gas ozone. Often the vendors of ozone generators make statements and distribute material that lead the public to believe that these devices are always safe and effective in controlling indoor air pollution. For almost a century, health professionals have refuted these claims (Sawyer, et. al 1913; Salls, 1927; Boeniger, 1995; American Lung Association, 1997; Al-Ahmady, 1997). The purpose of this document is to provide accurate information regarding the use of ozone-generating devices in indoor occupied spaces. This information is based on the most credible scientific evidence currently available.

Some vendors suggest that these devices have been approved by the federal government for use in occupied spaces. To the contrary, **NO** agency of the federal government has approved these devices for use in occupied spaces. Because of these claims, and because ozone can cause health problems at high concentrations, several federal government agencies have worked in consultation with the U.S. Environmental Protection Agency to produce this public information document.

Table of Contents

[What is ozone](#)
[How is ozone harmful](#)
[Is there such a thing as "good ozone," and "bad ozone"](#)
[Are ozone generators effective in controlling indoor air pollution](#)
[If I follow manufacturers' directions, can I be harmed](#)
[Why is it difficult to control ozone exposure with an ozone generator](#)
[Can ozone be used in unoccupied spaces](#)
[What other methods can be used to control indoor air pollution](#)
[Conclusions](#)
[Recommendation](#)
Additional Resources
- [Publications](#)
- [Information Sources](#)
[Bibliography](#)

WHAT IS OZONE?

Ozone is a molecule composed of three atoms of oxygen. Two atoms of oxygen form the basic oxygen molecule--the oxygen we breathe that is essential to life. The third oxygen atom can detach from the ozone molecule, and re-attach to molecules of other substances, thereby altering their chemical composition. It is this ability to react with other substances that forms the basis of manufacturers' claims.



HOW IS OZONE HARMFUL?

The same chemical properties that allow high concentrations of ozone to react with organic material outside the body give it the ability to react with similar organic material that makes up the body, and potentially cause harmful health consequences. [When inhaled, ozone can damage the lungs.](#) Relatively low amounts can cause chest pain, coughing, shortness of breath, and, throat irritation. Ozone may also worsen chronic respiratory diseases such as asthma and compromise the ability of the body to fight respiratory infections. People vary widely in their susceptibility to ozone. Healthy people, as well as those with respiratory difficulty, can experience breathing problems when exposed to ozone. Exercise during exposure to ozone causes a greater amount of ozone to be inhaled, and increases the risk of harmful respiratory effects. Recovery from the harmful effects can occur following short-term exposure to low levels of ozone, but health effects may become more damaging and recovery less certain at higher levels or from longer exposures (US EPA, 1996a, 1996b).

Manufacturers and vendors of ozone devices often use misleading terms to describe ozone. Terms such as "energized oxygen" or "pure air" suggest that ozone is a healthy kind of oxygen. Ozone is a toxic gas with vastly different chemical and toxicological properties from oxygen. Several federal agencies have established health standards or recommendations to limit human exposure to ozone. These exposure limits are summarized in Table 1.

Table 1. Ozone Health Effects and Standards

| Health Effects | Risk Factors | Health Standards* |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Potential risk of experiencing: Decreases in lung function Aggravation of asthma Throat irritation and cough Chest pain and shortness of breath Inflammation of lung tissue Higher susceptibility to respiratory infection | Factors expected to increase risk and severity of health effects are: Increase in ozone air concentration Greater duration of exposure for some health effects Activities that raise the breathing rate (e.g., exercise) Certain pre-existing lung diseases (e.g., asthma) | The Food and Drug Administration (FDA) requires ozone output of indoor medical devices to be no more than 0.05 ppm. The Occupational Safety and Health Administration (OSHA) requires that workers not be exposed to an average concentration of more than 0.10 ppm for 8 hours. The National Institute of Occupational Safety and Health (NIOSH) recommends an upper limit of 0.10 ppm, not to be exceeded at any time. The Environmental Protection Agency (EPA)'s National Ambient Air Quality Standard for ozone is a maximum 8 hour average outdoor concentration of 0.08 ppm. |
| (* ppm = parts per million) | | |

IS THERE SUCH A THING AS "GOOD OZONE" AND "BAD OZONE"?

The phrase "[good up high - bad nearby](#)" has been used by the U.S. Environmental Protection Agency (EPA) to make the distinction between ozone in the upper and lower atmosphere. Ozone in the upper atmosphere--referred to as "stratospheric ozone"--helps filter out damaging ultraviolet radiation from the sun. Though ozone in the stratosphere is protective, ozone in the atmosphere - which is the air we breathe - can be harmful to the respiratory system. Harmful levels of ozone can be produced by the interaction of sunlight with certain chemicals emitted to the environment (e.g., automobile emissions and chemical emissions of industrial plants). These harmful concentrations of ozone in the atmosphere are often accompanied by high concentrations of other pollutants, including nitrogen dioxide, fine particles, and hydrocarbons. **Whether pure or mixed with other chemicals, ozone can be harmful to health.**



ARE OZONE GENERATORS EFFECTIVE IN CONTROLLING INDOOR AIR POLLUTION?

Available scientific evidence shows that at concentrations that do not exceed public health standards, ozone has little potential to remove indoor air contaminants. Some manufacturers or vendors suggest that ozone will render almost every chemical contaminant harmless by producing a chemical reaction whose only by-products are carbon dioxide, oxygen and water. This is misleading.

- First, a review of scientific research shows that, for many of the chemicals commonly found in indoor environments, the reaction process with ozone may take months or years (Boeniger, 1995). For all practical purposes, ozone does not react at all with such chemicals. And contrary to specific claims by some vendors, ozone generators are not effective in removing carbon monoxide (Salls, 1927; Shaughnessy et al., 1994) or formaldehyde (Esswein and Boeniger, 1994).
- Second, for many of the chemicals with which ozone does readily react, the reaction can form a variety of harmful or irritating by-products (Weschler et al., 1992a, 1992b, 1996; Zhang and Liroy, 1994). For example, in a laboratory experiment that mixed ozone with chemicals from new carpet, ozone reduced many of these chemicals, including those which can produce new carpet odor. However, in the process, the reaction produced a variety of aldehydes, and the total concentration of organic chemicals in the air increased rather than decreased after the introduction of ozone (Weschler, et. al., 1992b). In addition to aldehydes, ozone may also increase indoor concentrations of formic acid (Zhang and Liroy, 1994), both of which can irritate the lungs if produced in sufficient amounts. Some of the potential by-products produced by ozone's reactions with other chemicals are themselves very reactive and capable of producing irritating and corrosive by-products (Weschler and Shields, 1996, 1997a, 1997b). Given the complexity of the chemical reactions that occur, additional research is needed to more completely understand the complex interactions of indoor chemicals in the presence of ozone.
- Third, ozone does not remove particles (e.g., dust and pollen) from the air, including the particles that cause most allergies. However, some ozone generators are manufactured with an "ion generator" or "ionizer" in the same unit. An ionizer is a device that disperses negatively (and/or positively) charged ions into the air. These ions attach to particles in the air giving them a negative (or positive) charge so that the particles may attach to nearby surfaces such as walls or furniture, or attach to one another and settle out of the air. In recent experiments, ionizers were found to be less effective in removing particles of dust, tobacco smoke, pollen or fungal spores than either high efficiency particle filters or electrostatic precipitators. (Shaughnessy et al., 1994; Pierce, et al., 1996). However, it is apparent from other experiments that the effectiveness of particle air cleaners, including electrostatic precipitators, ion generators, or pleated filters varies widely (U.S. EPA, 1995).

There is evidence to show that at concentrations that do not exceed public health standards, ozone is not effective at removing many odor-causing chemicals.

- In an experiment designed to produce formaldehyde concentrations representative of an embalming studio, where formaldehyde is the main odor producer, ozone showed no effect in reducing formaldehyde concentration (Esswein and Boeniger, 1994). Other experiments suggest that body odor may be masked by the smell of ozone but is not removed by ozone (Witheridge and Yaglou, 1939). Ozone is not considered useful for odor removal in building ventilation systems (ASHRAE, 1989).
- While there are few scientific studies to support the claim that ozone effectively removes odors, it is plausible that some odorous chemicals will react with ozone. For example, in some experiments, ozone appeared to react readily with certain chemicals, including some chemicals that contribute to the smell of new carpet (Weschler, 1992b; Zhang and Liroy, 1994). Ozone is also believed to react with acrolein, one of the many odorous and irritating chemicals found in secondhand tobacco smoke (US EPA, 1995).



If used at concentrations that do not exceed public health standards, ozone applied to indoor air does not effectively remove viruses, bacteria, mold, or other biological pollutants.

- Some data suggest that low levels of ozone may reduce airborne concentrations and inhibit the growth of some biological organisms while ozone is present, but ozone concentrations would have to be 5 - 10 times higher than public health standards allow before the ozone could decontaminate the air sufficiently to prevent survival and regeneration of the organisms once the ozone is removed (Dyas, et al., 1983; Foarde et al., 1997).
- Even at high concentrations, ozone may have no effect on biological contaminants embedded in porous material such as duct lining or ceiling tiles (Foarde et al, 1997). In other words, ozone produced by ozone generators may inhibit the growth of some biological agents while it is present, but it is unlikely to fully decontaminate the air unless concentrations are high enough to be a health concern if people are present. Even with high levels of ozone, contaminants embedded in porous material may not be affected at all.

IF I FOLLOW MANUFACTURERS' DIRECTIONS, CAN I BE HARMED?

Results of some controlled studies show that concentrations of ozone considerably higher than these standards are possible even when a user follows the manufacturer's operating instructions. There are many brands and models of ozone generators on the market. They vary in the amount of ozone they can produce. In many circumstances, the use of an ozone generator may not result in ozone concentrations that exceed public health standards. But many factors affect the indoor concentration of ozone so that under some conditions ozone concentrations may exceed public health standards.

- In one study (Shaughnessy and Oatman, 1991), a large ozone generator recommended by the manufacturer for spaces "up to 3,000 square feet," was placed in a 350 square foot room and run at a high setting. The ozone in the room quickly reached concentrations that were exceptionally high--0.50 to 0.80 ppm which is 5-10 times higher than public health limits ([see Table 1](#)).
- In an EPA study, several different devices were placed in a home environment, in various rooms, with doors alternately opened and closed, and with the central ventilation system fan alternately turned on and off. The results showed that some ozone generators, when run at a high setting with interior doors closed, would frequently produce concentrations of 0.20 - 0.30 ppm. A powerful unit set on high with the interior doors opened achieved values of 0.12 to 0.20 ppm in adjacent rooms. When units were not run on high, and interior doors were open, concentrations generally did not exceed public health standards (US EPA, 1995).
- The concentrations reported above were adjusted to exclude that portion of the ozone concentration brought in from the outdoors. Indoor concentrations of ozone brought in from outside are typically 0.01- 0.02 ppm, but could be as high as 0.03 - 0.05 ppm (Hayes, 1991; U.S. EPA, 1996b; Weschler et al., 1989, 1996; Zhang and Liou; 1994). *If the outdoor portion of ozone were included in the indoor concentrations reported above, the concentrations inside would have been correspondingly higher, increasing the risk of excessive ozone exposure.*
- None of the studies reported above involved the simultaneous use of more than one device. The simultaneous use of multiple devices increases the total ozone output and therefore greatly increases the risk of excessive ozone exposure.



WHY IS IT DIFFICULT TO CONTROL OZONE EXPOSURE WITH AN OZONE GENERATOR?

The actual concentration of ozone produced by an ozone generator depends on many factors. Concentrations will be higher if a more powerful device or more than one device is used, if a device is placed in a small space rather than a large space, if interior doors are closed rather than open and, if the room has fewer rather than more materials and furnishings that adsorb or react with ozone and, provided that outdoor concentrations of ozone are low, if there is less rather than more outdoor air ventilation.

The proximity of a person to the ozone generating device can also affect one's exposure. The concentration is highest at the point where the ozone exits from the device, and generally decreases as one moves further away.

Manufacturers and vendors advise users to size the device properly to the space or spaces in which it is used. Unfortunately, some manufacturers' recommendations about appropriate sizes for particular spaces have not been sufficiently precise to guarantee that ozone concentrations will not exceed public health limits. Further, some literature distributed by vendors suggests that users err on the side of operating a more powerful machine than would normally be appropriate for the intended space, the rationale being that the user may move in the future, or may want to use the machine in a larger space later on. Using a more powerful machine increases the risk of excessive ozone exposure.

Ozone generators typically provide a control setting by which the ozone output can be adjusted. The ozone output of these devices is usually **not** proportional to the control setting. That is, a setting at medium does not necessarily generate an ozone level that is halfway between the levels at low and high. The relationship between the control setting and the output varies considerably among devices, although most appear to elevate the ozone output much more than one would expect as the control setting is increased from low to high. In experiments to date, the high setting in some devices generated 10 times the level obtained at the medium setting (US EPA, 1995). Manufacturer's instructions on some devices link the control setting to room size and thus indicate what setting is appropriate for different room sizes. However, room size is only one factor affecting ozone levels in the room.

In addition to adjusting the control setting to the size of the room, users have sometimes been advised to lower the ozone setting if they can smell the ozone. Unfortunately, the ability to detect ozone by smell varies considerably from person to person, and one's ability to smell ozone rapidly deteriorates in the presence of ozone. While the smell of ozone may indicate that the concentration is too high, lack of odor does not guarantee that levels are safe.

At least one manufacturer is offering units with an ozone sensor that turns the ozone generator on and off with the intent of maintaining ozone concentrations in the space below health standards. EPA is currently evaluating the effectiveness and reliability of these sensors, and plans to conduct further research to improve society's understanding of ozone chemistry indoors. EPA will report its findings as the results of this research become available.

CAN OZONE BE USED IN UNOCCUPIED SPACES?

Ozone has been extensively used for water purification, but ozone chemistry in water is not the same as ozone chemistry in air. High concentrations of ozone in air, **when people are not present**, are sometimes used to help decontaminate an unoccupied space from certain chemical or biological contaminants or odors (e.g., fire restoration). However, little is known about the chemical by-products left behind by these processes (Dunston and Spivak, 1997). While high concentrations of ozone in air may sometimes be appropriate in these circumstances, **conditions should be sufficiently controlled to insure that no person or pet becomes exposed**. Ozone can adversely affect indoor plants, and damage materials such as rubber, electrical wire coatings, and fabrics and art work containing susceptible dyes and pigments (U.S. EPA, 1996a).



WHAT OTHER METHODS CAN BE USED TO CONTROL INDOOR AIR POLLUTION?

The [three most common approaches to reducing indoor air pollution](#), in order of effectiveness, are:

- **Source Control:** Eliminate or control the sources of pollution;
- **Ventilation:** Dilute and exhaust pollutants through outdoor air ventilation, and
- **Air Cleaning:** Remove pollutants through proven air cleaning methods.

Of the three, the first approach -- **source control** -- is the most effective. This involves minimizing the use of products and materials that cause indoor pollution, employing good hygiene practices to minimize biological contaminants (including the control of humidity and moisture, and occasional cleaning and disinfection of wet or moist surfaces), and using good housekeeping practices to control particles.

The second approach -- **outdoor air ventilation** -- is also effective and commonly employed. Ventilation methods include installing an exhaust fan close to the source of contaminants, increasing outdoor air flows in mechanical ventilation systems, and opening windows, especially when pollutant sources are in use.

The third approach -- **air cleaning** -- is not generally regarded as sufficient in itself, but is sometimes used to supplement source control and ventilation. Air filters, electronic particle air cleaners and ionizers are often used to remove airborne particles, and gas adsorbing material is sometimes used to remove gaseous contaminants when source control and ventilation are inadequate.

See [Additional Resources section](#) below for more detailed information about these methods.

CONCLUSIONS

Whether in its pure form or mixed with other chemicals, ozone can be harmful to health. When inhaled, ozone can damage the lungs. Relatively low amounts of ozone can cause chest pain, coughing, shortness of breath and, throat irritation. It may also worsen chronic respiratory diseases such as asthma as well as compromise the ability of the body to fight respiratory infections.

Some studies show that ozone concentrations produced by ozone generators can exceed health standards even when one follows manufacturer's instructions. Many factors affect ozone concentrations including the amount of ozone produced by the machine(s), the size of the indoor space, the amount of material in the room with which ozone reacts, the outdoor ozone concentration, and the amount of ventilation. These factors make it difficult to control the ozone concentration in all circumstances.

Available scientific evidence shows that, at concentrations that do not exceed public health standards, ozone is generally ineffective in controlling indoor air pollution. The concentration of ozone would have to greatly exceed health standards to be effective in removing most indoor air contaminants. In the process of reacting with chemicals indoors, ozone can produce other chemicals that themselves can be irritating and corrosive.

RECOMMENDATION

The public is advised to use proven methods of controlling indoor air pollution. These methods include eliminating or controlling pollutant sources, increasing outdoor air ventilation, and using proven methods of air cleaning.



Indoor Air

Consumers Union report - ozone

... a dangerous pollutant, not an air pollution cure-all.

Ozone is being touted as a solution to indoor air pollution, when, in fact, it is a powerful oxidizing agent - much like chlorine gas. The best concentration of ozone in the air we breathe is zero, because each high-energy molecule of ozone can react with and destroy an organic (carbon-chain) molecule. That's us!

This is what Consumers Union has to say on the subject:

"Ozone can purify drinking water, disinfect mildewed boats, and deodorize fire-ravaged buildings. But ozone is also a toxic gas, a component of smog, with no known beneficial health effects. The U.S. Occupational Safety and Health Administration (OSHA) limits ozone exposure in industrial settings to 100 parts per billion (ppb) over an eight-hour day, six days per week. At that level, ozone irritates the eyes, makes the throat feel dry, and stresses the lungs. The U.S. Food and Drug Administration (FDA) has set a limit of 50 ppb for the ozone from electronic air cleaners. That's a sensible limit for the home.

An ozone generator uses a high-voltage electric charge to convert oxygen in the air (O₂) to ozone (O₃), a pungent, powerful oxidant. At sufficiently high concentrations, ozone attacks and destroys gas molecules and microorganisms. Ozone has no effect on dust and other particulates, however. And ozone generators sold for home use can actually foul the air.

Given those facts, an ozone-generating air cleaner would seem a contradiction in terms. To date, Consumers Union has not found a unit that allows users to measure ozone output or to control ozone levels in a meaningful way. Some promotional materials say you can tell if ozone levels are too high when the distinctive odor becomes apparent. But research has shown that odor isn't a reliable yardstick.

When Consumers Union tested ozone generators under a variety of conditions, they almost always produced ozone levels well above the FDA's limit of 50 ppb. Although ozone generators have limited value in unoccupied spaces, it's highly questionable whether they belong where people breathe."



OSHA

Occupational Safety & Health Administration
U.S. Department of Labor

Home
Index
Search

OSHA Standards Interpretation and Compliance Letters

A. 09/29/1994 - Occupational Safety and Health Administration's (OSHA) regulations for ozone.

-
- **Record Type:** Interpretation
 - **Standard Number:** [1910.1000](#); [1910.1200](#)
 - **Subject:** Occupational Safety and Health Administration's (OSHA) regulations for ozone.
 - **Information Date:** 09/29/1994
-

September 29, 1994

[Name Withheld]

Dear [Name Withheld]:

This is in further response to your letter of July 26, concerning the Occupational Safety and Health Administration's (OSHA) regulations for ozone. Please accept our apology for the delay in this response.

OSHA regulates employee exposure to ozone gas through its Air Contaminants Standard, 29 CFR 1910.1000 (copy enclosed). The permissible exposure limit (PEL) is listed in Table Z-1 as an 8-hour, time-weighted average value of 0.1 part of ozone per million parts of air (ppm). Rule 29 CFR 1910.1000(e) requires that administrative or engineering controls must first be identified and implemented whenever feasible to achieve compliance with the PEL. When such controls are not feasible to achieve compliance, personal protective equipment, respirators, or any other protective measures shall be used to keep the exposure of employees to ozone gas within the PEL.

Another applicable OSHA standard is the Hazard Communication Standard (HCS), 29 CFR 1910.1200 (copy enclosed). The HCS provides workers exposed to hazardous chemicals with the "right to know" the identities and hazards of those materials, as well as appropriate protective measures. When workers have such information, they are able to take steps to protect themselves from experiencing adverse effects from chemical exposure.

The HCS requires employers to develop and implement a written hazard communication program for their workplace if their employees are exposed to hazardous chemicals. Employers are also required to ensure containers are labeled with an appropriate hazard warning; maintain material safety data sheets (MSDSs) in the workplace and make them readily accessible to exposed workers; and train employees to understand the hazards, know how to protect themselves, and be able to use the available labels and MSDSs. The labels and MSDSs are developed by the chemical manufacturer or importer of the product and provided to downstream employers when they obtain the hazardous chemical for use in the workplace.

We appreciate the opportunity to assist you. Should you require further assistance please feel free to contact OSHA's Office of Health Compliance Assistance at (202) 219-8036.

Sincerely,

John B. Miles, Jr., Director
Directorate of Compliance Programs



OSHA Standards Interpretation and Compliance Letters

B. 04/03/1995 - The use of ozone gas from ozone generators in a large room.

- **Record Type:** Interpretation
 - **Standard Number:**
 - **Subject:** The use of ozone gas from ozone generators in a large room.
 - **Information Date:** 04/03/1995
-

April 3, 1995

Mr. Exley E. Wical
1050 Forest Drive
Tavares, Florida 32778

Dear Mr. Wical:

This letter is in response to your questioning the use of ozone gas from ozone generators in a large room where 225 to 250 senior citizens play bingo. While ozone is occasionally suggested as a room air additive to freshen the air, we would not recommend the practice unless strictly controlled.

Ozone at concentrations above 0.05 parts per million (ppm) is associated with respiratory and other health related problems. Exposures to ozone above this level can result in headaches, throat and nasal dryness, bronchitis, decreased pulmonary function capacity, and other respiratory ailments. With a population of senior citizens, many of which may already have decreased pulmonary function, adding ozone may compound their problem. If ozone were to be added to the room, the levels would have to be kept well below 0.05 ppm to assure an adequate safety margin.

Most indoor air problems are associated with an inadequate supply of fresh outside air. The fact that you are bringing in 25% fresh air through the air conditioning system should be sufficient.

You indicated that people smoke in the room, this will of course compound any indoor air problems. The electrostatic filters will help, but realistically, smoking should not be allowed. By further increasing the percent of fresh air intake one will improve the air quality. As a quick check on the quality of the air one can look at the level of carbon dioxide. As the population inside a building increases the level of carbon dioxide will also increase. Ambient carbon dioxide levels generally run between 250 and 400 ppm. If the carbon dioxide level inside a building is above 700 ppm it is generally considered indicative of poor indoor air quality. This check should be done towards the end of the period when the room has been fully occupied. Increasing the fresh air intake is the usual recommendation if a carbon dioxide problem is found.

I hope that this information answers your question. If you have any further questions please contact Richard Fairfax of my staff at (202) 219-8036.

Sincerely yours,

Ruth McCully, Director
Office of Health Compliance Assistance Exley E. Wical
1050 Forest Drive
Tavares, Florida 32778



March 21, 1995

(I am Building Chairman for)
(the Lake County Shrine Club)
(Tavares, Florida)

Ms. Ruth McCully
OSHA Room N 3467
200 Constitution Avenue N.W.
Washington D.C. 20010

Dear Ms. McCully;

This letter is in confirmation of my telephone conversation today with Mr. Richard Fairfax.

I explained to him my concern about adding ozone gas, by use of ozone generators, to the air in a large room where 225 to 250 Senior Citizens play bingo; their average age is over 65 yrs. (We do not now add ozone gas to the air in this room.)

Please write a letter to me explaining why it is not advisable to add ozone gas to the air in our room.

We now add 25% fresh air through air conditioning system which gives us a complete fresh air change 4 times per hour, we also have 7 electrostatic air filters which filter the air 10.4 times per hour.

Any suggestions you may have to improve the quality of air in the above situation will be appreciated. Smoke is a problem.

Sincerely,

Exley E. Wical



United States Environmental Protection Agency
Office of Air & Radiation
Office of Air Quality Planning & Standards

FACT SHEET



July 17, 1997

HEALTH AND ENVIRONMENTAL EFFECTS OF GROUND-LEVEL OZONE

Why are We Concerned about Ground-Level Ozone?

- Ozone is the prime ingredient of smog in our cities and other areas of the country. Though it occurs naturally in the stratosphere to provide a protective layer high above the earth, at ground-level it is the prime ingredient of smog.
- When inhaled, even at very low levels, ozone can:
 - cause acute respiratory problems;
 - aggravate asthma;
 - cause significant temporary decreases in lung capacity of 15 to over 20 percent in some healthy adults;
 - cause inflammation of lung tissue;
 - lead to hospital admissions and emergency room visits [10 to 20 percent of all summertime respiratory-related hospital visits in the northeastern U.S. are associated with ozone pollution]; and
 - impair the body's immune system defenses, making people more susceptible to respiratory illnesses, including bronchitis and pneumonia.



Who is Most at Risk from Exposure to Ground-Level Ozone?

- Children are most at risk from exposure to ozone:
 - The average adult breathes 13,000 liters of air per day. Children breathe even more air per pound of body weight than adults.
 - Because children's respiratory systems are still developing, they are more susceptible than adults to environmental threats.
 - Ground-level ozone is a summertime problem. Children are outside playing and exercising during the summer months at summer camps, playgrounds, neighborhood parks and in backyards.
- Asthmatics and Asthmatic Children:
 - Asthma is a growing threat to children and adults. Children make up 25 percent of the population and comprise 40 percent of the asthma cases.
 - Fourteen Americans die every day from asthma, a rate three times greater than just 20 years ago. African-Americans die at a rate six times that of Caucasians.
 - For asthmatics having an attack, the pathways of the lungs become so narrow that breathing becomes akin to sucking a thick milk shake through a straw.
 - Ozone can aggravate asthma, causing more asthma attacks, increased use of medication, more medical treatment and more visits to hospital emergency clinics.
- Healthy Adults:
 - Even moderately exercising healthy adults can experience 15 to over 20 percent reductions in lung function from exposure to low levels of ozone over several hours.
 - Damage to lung tissue may be caused by repeated exposures to ozone -- something like repeated sunburns of the lungs -- and this could result in a reduced quality of life as people age. Results of animal studies indicate that repeated exposure to high levels of ozone for several months or more can produce permanent structural damage in the lungs.
 - Among those most at risk to ozone are people who are outdoors and moderately exercising during the summer months. This includes construction workers and other outdoor workers.

How does Ground-Level Ozone Harm the Environment?

- Ground-level ozone interferes with the ability of plants to produce and store food, so that growth, reproduction and overall plant health are compromised.
- By weakening sensitive vegetation, ozone makes plants more susceptible to disease, pests, and environmental stresses.
- Ground-level ozone has been shown to reduce agricultural yields for many economically important crops (e.g., soybeans, kidney beans, wheat, cotton).
- The effects of ground-level ozone on long-lived species such as trees are believed to add up over many years so that whole forests or ecosystems can be affected. For example, ozone can adversely impact ecological functions such as water movement, mineral nutrient cycling, and habitats for various animal and plant species.
- Ground-level ozone can kill or damage leaves so that they fall off the plants too soon or become spotted or brown. These effects can significantly decrease the natural beauty of an area, such as in national parks and recreation areas.
- One of the key components of ozone, nitrogen oxides, contributes to fish kills and algae blooms in sensitive waterways, such as the Chesapeake Bay.



What Improvement Would Result from EPA's New Standards?

EPA's new ozone standards will provide increased protection beyond that provided by the previous standard from the following effects:

- Reduced risk of significant decreases (15% to over 20%) in children's lung functions (such as difficulty in breathing or shortness of breath), approximately 1 million fewer incidences each year, which can limit a healthy child's activities or result in increased medication use, or medical treatment, for children with asthma
- Reduced risk of moderate to severe respiratory symptoms in children, hundreds of thousands of fewer incidences each year of symptoms such as aggravated coughing and difficult or painful breathing
- Reduced risk of hospital admissions and emergency room visits for respiratory causes, thousands fewer admissions and visits for individuals with asthma
- Reduced risks of more frequent childhood illnesses and more subtle effects such as repeated inflammation of the lung, impairment of the lung's natural defense mechanisms, increased susceptibility to respiratory infection, and irreversible changes in lung structure. Such risks can lead to chronic respiratory illnesses such as emphysema and chronic bronchitis later in life and/or premature aging of the lungs
- Reduce the yield loss of major agricultural crops, such as soybeans and wheat, and commercial forests by almost \$500,000,000.

Background: What is Ground-level Ozone?

- Ozone is not emitted directly into the air, but is formed by gases called nitrogen oxides (NO_x) and volatile organic compounds (VOCs) that in the presence of heat and sunlight react to form ozone. Ground-level ozone forms readily in the atmosphere, usually during hot weather.
 - NO_x is emitted from motor vehicles, power plants and other sources of combustion. VOCs are emitted from a variety of sources, including motor vehicles, chemical plants, refineries, factories, consumer and commercial products, and other industrial sources.
 - Changing weather patterns contribute to yearly differences in ozone concentrations from city to city. Also, ozone and the pollutants that cause ozone can be carried to an area from pollution sources located hundreds of miles upwind.
-



Ozone Generators

What Is Ozone Air Pollution?

Ozone is a potent lung irritant and exposure to elevated levels is a contributor to the exacerbation of lung disease; it is especially dangerous for persons with asthma and other chronic lung diseases, children, and the elderly. Residential indoor ozone is produced directly by ozone generators and indirectly by ion generators and some other electronic air cleaners. There is no difference, despite some manufacturers' claims, between outdoor ozone and ozone produced by these devices.

The Federal Trade Commission (FTC) took action in 1995 against two manufacturers of ozone generating devices. The FTC charged that they made unsubstantiated claims about the ability of their products to clean air of various indoor air pollutants and to prevent or relieve allergies, asthma and other conditions. Under the FTC's settlement, the manufacturers are prohibited from making marketing claims that ozone is effective in cleaning indoor air, that their products do not create harmful by-products, and that they prevent or provide relief from allergies, asthma, and other specified conditions, unless the claims are supported by reliable and adequate substantiation (FTC, 1995).

Consumer Reports (1992), the National Institute of Occupational Safety and Health (NIOSH) (Boeniger, 1995), and the U.S. EPA (1995) concluded that tabletop and room unit ozone generators are not effective in improving indoor air quality. Studies have found that while some indoor air pollutant concentrations decline in the presence of ozone, other pollutants increase. In fact, upon reaction with ozone, some previously undetected, toxic chemicals emerge in indoor air, including formaldehyde and other aldehydes (Boeniger, 1995). There is a lack of evidence in the scientific literature that would support the effectiveness of ozone at low concentrations in removing organic contaminants from indoor air (Boeniger, 1995). A recent study by the U.S. EPA demonstrates that ozone is not effective for killing airborne molds and fungi even at high concentrations (6-9 ppm) (U.S. EPA, 1995). At higher concentrations, especially above 0.08 ppm, ozone is a potent irritant that can bring about diminished lung function, cough, inflammation associated with biochemical changes, and increased responsiveness to allergens (Horstman, et al., 1990). Current evidence of the health effects of ozone suggests that there is no "safe" threshold concentration for the onset of health responses due to exposure above background ozone concentrations (Burnett, et al., 1994; U.S. EPA CASAC letter, 1995). Also, simultaneous exposure to ozone and other compounds may produce additive or synergistic effects (Last, et al., 1984; Peden, et al., 1995). In addition, persons with asthma have increased susceptibility to ozone and exposure to low concentrations results in increased symptoms, medications use and hospitalizations.

The FDA has set a limit of 0.05 ppm of ozone for medical devices. A small percentage of cleaners that claim a health benefit are listed by the FDA and these devices conform to FDA regulations. However, ozone generators, negative ion generators, and certain other electronic air cleaners that are not listed by the FDA, or cannot otherwise prove that their ozone emission levels are lower than 0.05 ppm, may produce levels of ozone recognized as unsafe for humans and are not recommended for use in occupied spaces because of the risk of generation of ozone. For similar reasons, the American Lung Association does not suggest the use of these products.

For more information, email the **American Lung Association of Washington** at alaw@alaw.org or call us at (206) 441-5100, or 1-800-732-9339 (within Washington state only). No matter where you live in the United States, you can call **your local American Lung Association** at **1-800-LUNG-USA**.