



March 2006

## Beware of Ozone-generating Indoor "Air Purifiers"

Some devices that are advertised as "air purifiers" or air cleaners purposely emit large amounts of ozone, the main component of smog! Not only are such ozone generators ineffective at cleaning indoor air, but breathing ozone poses serious health risks. This fact sheet discusses these health risks and provides effective, alternative solutions to indoor air quality problems. Further details, including a list of brands and models of ozone generators, can be obtained at: <http://www.arb.ca.gov/research/indoor/ozone.htm>. The Air Resources Board recommends that ozone generators not be used.

### What are ozone-generating air cleaners?

Some indoor "air purifiers" or air cleaners emit ozone, a major component of outdoor smog, either intentionally or as a by-product of their design. Those that intentionally emit ozone are often called "ozone generators," and are the focus of this fact sheet. Manufacturers sometimes inappropriately refer to ozone as "activated oxygen," "super oxygenated" or "energized oxygen," implying that ozone is a healthy kind of oxygen. Because ozone reacts with some other molecules, manufacturers claim that the ozone produced by these devices can purify the air and remove airborne particles, chemicals, mold, viruses, bacteria, and odors. However, ozone is not effective at cleaning the air except at extremely high, unsafe ozone levels, and then it is only partially effective.



*Common ozone generators*

Ionizers and electrostatic precipitators are other types of air cleaners that emit ozone, but do so as a by-product of their design and function. These devices are designed to electrically charge particles and remove them from the air; ozone is released through the charging process. These devices typically emit less ozone than ozone generators.

### What is ozone?

Ozone is a molecule composed of three oxygen atoms. It is a highly reactive, unstable, toxic gas. Ground level ozone is a major component of photochemical smog that plagues larger cities during the summertime. There is also a layer of ozone high up in the atmosphere, called stratospheric ozone, that protects us by reducing the amount of ultraviolet light entering the earth's atmosphere. This beneficial ozone layer should not be confused with the harmful ozone that occurs at ground level.

## What are the adverse health effects from exposure to ozone?

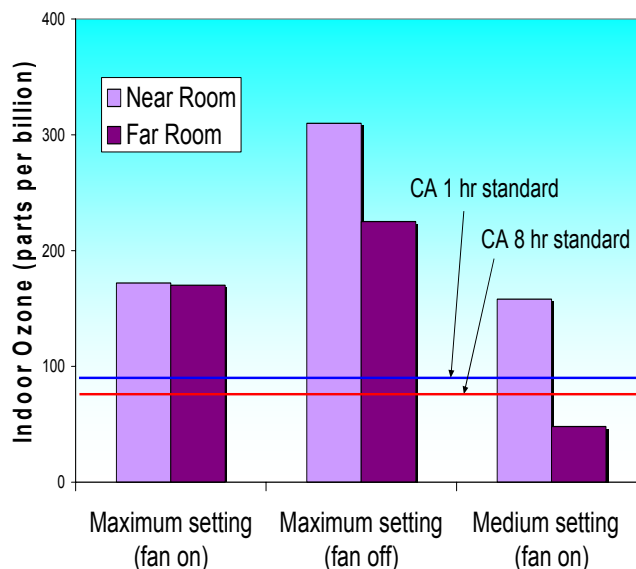
Buyers of ozone generators may not be aware that ozone can harm the cells in the lungs and respiratory airways. Exposure to ozone irritates and inflames the lining of the respiratory system. It causes symptoms including coughing, chest tightness, and shortness of breath. In persons with asthma, ozone can worsen asthma symptoms, and one study indicates that ozone may contribute to the development of asthma. Ozone impairs breathing. Elevated exposures to ozone can cause permanent lung damage, and repeated exposure can even increase the risk of dying among persons already in poor health.



Persons especially vulnerable include children and those who suffer from asthma or other respiratory diseases, including the elderly. Due to the health hazards of ozone, California has worked aggressively for decades to reduce outdoor ozone levels, with considerable success. For more information on the health effects of ozone, visit <http://www.arb.ca.gov/research/aaqs/caaqs/ozone/ozone.htm>. In addition to its impacts on health, ozone can also damage materials such as rubber, fabrics, plastics and other indoor furnishings.

## How much ozone do ozone generators produce?

Studies have shown that ozone generators can produce indoor ozone levels several times the state outdoor health standard of 90 parts per billion (ppb) for one hour, as well as the eight hour standard of 70 ppb. In one experiment, a level of 300 ppb was measured in a house after 1-2 hours of ozone generator use.<sup>1</sup> As shown, indoor ozone levels were about twice the health standard levels when the ozone generator was set on the maximum setting and the central fan was either on or off. Ozone levels were almost twice the health standard levels in the near room even when the device was set to a medium setting. These concentrations are equal to, or worse than, a first stage smog alert. It is clear that the ozone concentrations produced by these devices can easily exceed health-protective standards.



## Are ozone generators effective at cleaning air?

Some devices are marketed with advertising claims that they will kill viruses, bacteria, mold and other biological contaminants, and remove chemical contaminants and odors. However, studies have shown that, when ozone concentrations are below the health standards, it does not effectively remove biological contaminants. Ozone also does not remove particles (e.g. dust and pollen) from the air, including the particles responsible for most allergies. Research also shows that ozone generated by air purifiers does little to remove chemical pollutants. In fact, ozone has been found to react with existing chemicals in the air to create other toxic pollutants, most notably formaldehyde and ultrafine particles.

Some consumers purchase air purifiers to eradicate odors. Evidence shows that ozone concentrations below the health standards are not effective in removing many odor-causing chemicals. Ozone is also known to deaden one's sense of smell. Not only does this disguise rather than eliminate odors, it can also have the dangerous effect of decreasing a person's ability to detect high ozone levels.

Unlike the situation in air, ozone can be used successfully to purify water in some applications. This is so because high levels of ozone can be used in the water, most of the ozone reacts in the water, and people typically are not present when the ozone is used.

## Why are ozone generators still on the market?

If ozone generators are ineffective at removing air pollutants, and they pose major health risks to users, why do they continue to be sold? The unfortunate answer is that misleading advertising by manufacturers is very effective, and no government agency has the authority to fully regulate these devices. Thus, ARB is actively working to educate professionals and the public about the dangers of using ozone generators.

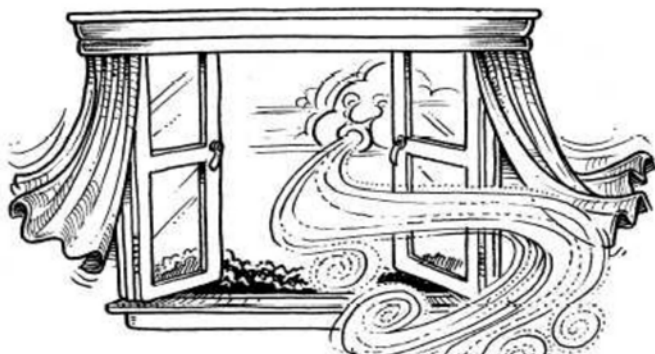
## What does the Air Resources Board recommend?

We strongly advise against the use of ozone generators in occupied spaces. Other governmental agencies agree with this advice.<sup>2,3</sup> A current list of ozone generators is available at: <http://www.arb.ca.gov/research/indoor/o3g-list.htm>.

Instead of using an air cleaner, consumers are encouraged to first eliminate or reduce indoor pollution sources and to ventilate well with outdoor air. The most effective method of controlling indoor air pollution is through prevention: eliminating pollution at its source. To minimize the release of pollutants indoors:

- carefully follow directions on consumer products such as cleaning agents, paints, and glues;
- properly maintain and operate gas- and wood-burning appliances;
- restrict smoking to outdoor areas;
- purchase building materials and wood furniture that do not emit formaldehyde;
- use candles and incense sparingly, if at all; and
- clean frequently and thoroughly to prevent dust and mold build-up.





Use plenty of ventilation: be sure there is adequate airflow to/from the outdoors. This can be achieved by opening windows, using exhaust fans near pollutant sources (e.g. above gas stoves), and increasing airflow through the use of mechanical ventilation systems. If your home is equipped with a central forced air system, you should also consider upgrading the filter.

## If I still need an air cleaner, how do I find a good one?

In some cases, air cleaners may be beneficial. Types of air cleaners include filters (including High Efficiency Particulate Air or “HEPA” filters), electrostatic precipitators, ionizers, and hybrid models. For help in selecting a good air cleaner, see our Fact Sheet entitled “Air Cleaning Devices for the Home – Frequently Asked Questions,” February 2005, available by calling the telephone number shown below, or online at: <http://www.arb.ca.gov/research/indoor/aircleaners.htm>. Additional information can be obtained by reviewing rankings of effectiveness published by manufacturers (see the Association of Home Appliance Manufacturers website at <http://www.cadr.org>, and reports by other reviewers such as Consumers Union (<http://www.consumerreports.org>).

**For more information:** California Air Resources Board  
Research Division  
Indoor Air Quality Program  
P. O. Box 2815  
Sacramento, CA 95812  
**(916) 322-8282 (indoor information message line)**

Indoor air quality guidelines are available at:  
<http://www.arb.ca.gov/research/indoor/indoor.htm>

If you would like to receive periodic updates and information about air cleaners and indoor air quality, please sign up for our email list serve at: <http://www.arb.ca.gov/listserv/listserv.php>.

<sup>1</sup> Mason, MA *et al.*, (2000), “Characterization of ozone emissions from air cleaners equipped with ozone generators and sensor and feedback control circuitry.” In: Engineering Solutions to Indoor Air Quality Programs Symposium, Research Triangle Park, NC. VIP-98, AWMA, July, pgs 254-269.

<sup>2</sup> U.S. Environmental Protection Agency (EPA; 2005), Fact Sheet: “Ozone Generators that are Sold as Air Cleaners: An Assessment of Effectiveness and Health Consequences.” (<http://www.epa.gov/iaq/pubs/ozonegen.html>).

<sup>3</sup> California Department of Health Services, (1997), Press release: “State Issues Warning About Ozone Air Cleaning Devices.” April, #27-97, Sacramento. <http://www.applications.dhs.ca.gov/pressreleases/store/pressreleases/27-97.html>.

If you are a person with disability and desire to obtain this document in an alternative format, please contact the Air Resources Board Coordinator at (916) 323-4916. Persons with hearing or speech impairments can contact us by using our Telephone Device for the Deaf (TDD) at (916) 324-9531, or (800) 700-8326 for TDD calls from outside the Sacramento area.

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## Potentially Hazardous Ozone Generators Sold as Air Purifiers Updated November 6, 2007

Some devices that are advertised as "air purifiers", air cleaners, or ozone generators purposely emit large amounts of ozone, the main component of smog! Not only are such ozone generators ineffective at cleaning indoor air, but breathing ozone poses serious health risks. The Air Resources Board recommends that these ozone generators not be used.

The following is a partial list of portable air cleaners sold as "air purifiers" or ozone generators that can intentionally emit ozone. This list includes air cleaners sold primarily for residential use, plus some for commercial, in-vehicle, and personal use. Inclusion on this list is based on information available at the time of review. These devices have not been tested by the Air Resources Board using the test protocol required by the recently approved regulation, and until the testing required by the regulation is completed, we do not know if the ozone emitted will exceed the recently adopted 0.050 ppm standard. Exclusion from this list is not to be construed as endorsement by the California Air Resources Board. In-duct systems and other non-portable ozone generators are not listed here, but may generate potentially harmful levels of ozone.

This list (updated November 6, 2007) will be updated periodically as information becomes available.

### **Air-Zone** (All models)

XT-120, XT-240, XT-400, XT-800, XT-2000, XT-4000, XT-6000, XT-14000, XT-28000

### **Airdow (ADA Air Purifier and Air Cleaner (Xiamen) Co., Ltd)**

ADA 311, 377, 388, 705, 706, 708, 717, 728, 729, 737, 739, 767

### **Allied Products/Biofeedback Instrument Corporation**

Kleen-Air King II Model 1004A, 1004, 1004 SP, 1007

### **Alpine**

Living Air Classic, XL-15, Breeze AT, LA1, LA2, Peak, Flair, Fresh Air, Personal Air Purifier

### **Applied Ozone Systems**

CS-1, CS-2

### **APSNA - Air & Water Purification Systems North America** (All models)

FA1, C3, BAT, F2

### **Aqua Sun Ozone International** (Certain models)

Model-(100, 202A, 206A, 217A, 308, 700,5000), Model-2500/Kleenair, Model-2500R/Kleenair

### **Aran Aqua Pollution Control Systems**

SS-Series Aranizers (SS-1, SS-3X, SS-4X, SS-6, SS-8, SS-10)

NS-Series Aranizers (NS-3, NS-5, NS-6, NS-8, NS-10)

### **Better Living**

Sun Aire Air Purifier

### **BioTech Research**

EdenPURE Area Air Purifier, EdenPURE Deluxe Air Purifier

### **Biozone** (All models)

50, 100, 102, 500, 1000, 2000, 3000, 4000, 5000, Travel Aire 50V, Travel Aire 250T

### **Breathe Pure**

QOZO-100, QOZO-500

### **Capital Vanguard Co., Ltd**

HV-(107, 109, 202, 202A,203A, 205, 206A, 207, 207A, 210A, 217A, 308), HV-2021+O3

### **Carspa Technology Co., Ltd**

Car0100, Car0300, Car0400

**Cliff Scott Enterprises** (All models)

CSE 100, CSE 101

**Codyson**

CD-100, CD-120, CD-210, CD-200, CD-2120, CD-2200

**Crystal Air** (All models)

CA45-2, DC Pro (200, 450, 970), Multizone 280, Pro (420, 700, 3400-1, 3600-1), UV Pro 550

**Csonka** (All models)

Original AirCare, Super AirCare, Pro AirCare, Automotive AirCare, Facility Control System AirCare, Car Fresh AirCare, Desk Fresh AirCare, Turbo Fresh AirCare

**Detail King**

PT-109

**EcoQuest** (Most models)

Fresh Air, Living Air Classic, Breeze AT, Flair, Fresh Air To Go, EcoBox

**Ecozone**

H-50, XL-250 SH, TS-50, M10

**Ez-com System, Inc.**

EA-8705, EW-300, EW600, EW-900, GW-250

**Enaly** (Most models)

OZX-A200B, OZX-A500B, OZX-A3500, OZX-A700, OZX-7000B

**Fresh-Aire (Triatomic Environmental, Inc.)**

T-30UV

**HealthWay Home Products, Inc.**

Healthway Air Deodorizer HW-DE01

**Hefei Sensing Electronic Co., Ltd.**

Ozone Air Purifier

**Imperial Products**

Air Fresh G-100, Moonland Desktop Ozone Purifier, SL-002 High Output Ozone Air Purifier, XJ-1000 Ionic Air Purifier, XJ-3000B Professional Ozone Air Purifier

**Jenesco** (All models)

DC-12, PT101, PT101W, PT109, PT109W, PRO-4, PRO-8, FM-1, FM-2

**King Air & Water Purification Corporation**

See Allied Products

**Lenntech** (All models)

Series 3000

**LightningAir**

LA-1XP/2500, LightningAir Plus 5PX series, LA-2SPX

**Longevity Resources**

ZipZone, EnviroPro (420, 700, 3400, 3600, 3600-5)

**Matsutek Enterprises Co., Ltd.**

ION737, AR-150, CA-320, CA-721

**Nanbai**

N206a, N208

**Natural Air**

Natural Air

**Nature's Air**

NA-2

**O3ozone**

DC Pro 450, Pro 700, DC Pro 970, UV Pro 550

**Odatus** (All models)

Odatus II

**Oxytech Research** (All models)

MGA-500, MGA-1000, MGA-2000, MGA-3500

**Ozomax, Ltd.**

Ozo Fresh 30

**Ozone Environmental Technologies**

Uvonair (1000, 3000, 5000)

**Ozone Solutions** (All models)

MZ-280, MZ-450, MZ-950, OMZ-420, OMZ-700, OMZ-1000, OUV-550, OMZ-2500, OMZ-3400

**Peaceful Breeze**

Small Room Air Purifier Model 388

**Peak Pure Air**

Peak O3 Air Purifier

**Prozone** (All Models)

PZ5-A, PZ2-2A, The Prozone (Purifier), Whole House Twister, PZ6-AIR, Whole House Air and Surface Purifier

**Pure 'n Natural** (Certain models)

OZ-2000 ( Odor Zapper ), Sani-Mate AS-250-B, NA50 Deodorizer/Air Freshener

**QCH Tradelink**

Medi-Aire

**Quantum Pure Aire**

AccuAire ALS-750, ALS-1500, ALS-3000, RMS-100, ClassicAire (CS-1000, CS-2000, CS-3500), XP-350

**Queenaire Technologies, Inc.**

QT Storm, QT Thunder, QT Thunder-24, QT Tornado, QT Cyclone, Newaire Plugin

**Rain Fresh Air**

RFA5000, RFA3500

**RainbowAir** (All models)

Newaire Plug In, Activator (250, 500, 1000)

**Shenyang Bodycare Ozone Research Insitute**

UV\_Portable, UV\_Wall Mount

**SpringAir** (Certain models)

CS-1, CS-2

**Sun Aire**

see Better Living

**Surround Air** (Certain models)

Multi-Tech

**Taoture International Enterprises, Inc.**

OZX-A200B, OZX-A500B

**TriMed AirMedic**

SBR-1, SBH-1, C12-1, C12-U1

**TriStar Enterprises, LLC**

PureStar XJ-3000D

**Trump Electronic Company**

TP-2, TP-3, TP-4, TP-5, TP-6, TCB-913GC

**Windchaser** (Certain models)

IF-1, IF-2, IMC-1

**Ultra-Pure (Real Spirit USA, Inc.)**

UP-988, UP-899, Pet-Pro 3800

**Zhuhai Large Horse Electrical Appliances Co., Ltd.**

HMA (300, 300/A, 300/A02, 300/H01, 300/H02, 300/RH, 300/RH01, 300/RH02, 600/O3)

**Zontec**

Perfect Air Plug-In, PA 100, PA 200, PA 300, O3 Air Purification System