The following pages have been taken from the STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING, PROPOSED REGULATION TO LIMIT OZONE EMISSIONS FROM INDOOR AIR CLEANING DEVICES, dated August 10, 2007
To see the complete report go to: http://www.arb.ca.gov/regact/2007/iacd07/isor.pdf

To adequately address the report, EcoQuest International has provided comments immediately following each paragraph where comments are warranted. Comments are in blue bold italics. We look forward to working with the Board to develop a regulation which both protects consumers and gives them access to this vital indoor air treatment technology.

EXECUTIVE SUMMARY

Regulation is Required and Necessary
Assembly Bill (AB) 2276 (Pavley, 2006; Health and Safety Code [HSC] Section 41986) directs the Air Resources Board (ARB) to develop and adopt regulations, consistent with federal law, to protect public health from ozone emitted by indoor air cleaning devices used in occupied spaces. Indoor air cleaning devices that produce ozone intentionally have been shown to produce unhealthful ozone concentrations well above the health-based State and Federal ambient air quality standards. Extensive scientific research has shown that exposure to ozone above these standard levels can cause respiratory symptoms (such as cough, wheeze, and difficulty breathing), reduced lung function, increased airway hyperreactivity, and increased airway inflammation. Additionally, exposure to ozone above the California standards has been associated with asthma onset and exacerbation, increased school absences**,** hospitalizations due to respiratory diseases, and premature death.

These conclusions come from studies which correlate outdoor ozone concentrations with asthma onset and exacerbation, increased school absences, hospitalizations due to respiratory diseases, and premature death. These studies fail to account for other constituents of outdoor air pollution. More recent studies show particulate matter, specifically PM2.5 is the primary culprit, not ozone. The staff will comment later that no epidemiological studies have been performed regarding the effects of indoor ozone on health.

While on the topic of public health concerns, almost 100,000 people die every year in U.S. hospitals due to infections acquired during their stay. It is one of the leading causes of death in this country. Although the Centers for Disease Control (CDC) has known about the dangers of infections for decades, the medical community has failed to make infection prevention a priority until State Legislatures started passing public disclosure laws--currently nineteen States have done so.

Infections not only cost lives, they cost money. The CDC estimates the national cost of hospital acquired infections (HAI) can be as much as $27.5 billion annually. These costs are paid for by US citizens, mostly through the added charges to Medicare, the largest payer of costs associated with hospital infections.

The proposed testing protocol by CA ARB would ban safe, scientifically proven devices capable of killing many if not all of these deadly infections. This ban would deny hospitals access to a viable option that they could use to help fight the spread of infections – potentially reducing the amount of deaths each year in hospitals throughout the State.

The only limit for air cleaning devices currently in place is the U.S. Food and Drug Administration's ozone emission concentration limit of 0.05 ppm for medical devices. ***(When tested in real world living conditions utilizing the latest state-of-the-art purifiers on the market, ozone levels are able to stay within these safe limits and are still 'highly effective' at purifying the air as well as sanitizing surfaces. Recent university peer reviewed and published studies back these claims!)***

Ozone Exposures are too High

Several different research groups have found that some ozone generating air cleaners produce ozone concentrations several times higher than the California Ambient Air Quality Standard (CAAQS) of 0.070 ppm, 8-hour average, and 0.09 ppm, 1-hour average (Phillips *et al.*, 1999; Mason *et al*., 2000; Tung *et al.*, 2005; Britigan *et al*., 2006; ARB, 2006a). Additionally, ARB staff measured ozone emissions at the face of current ozone generating air cleaners and observed ozone concentrations above 1 ppm at a distance of two inches from the face and concentrations as high as 0.567 ppm at a distance of 24 inches from the face (ARB, 2006a). ***(Where does it say in the owners manual or on the unit that consumers should hold their face 2-24 inches away from the face of the purifier for 1-8 hours?)*** These studies indicate that ozone emissions from indoor air cleaning devices can elevate room concentrations ***(How can these tests be accurate measurements of 'room concentrations' if the testing was done 2-24 inches from the face of purifier? This is the equivalent of measuring the heat of a room coming off a wall heater 2-24 inches away from the heater vs. the middle of the room. There is a reason why HVAC companies install the thermostat controller in the center of the room vs. 2-24 inches away from heater and air conditioner vents!)*** of ozone above State health-based standards, and create indoor ozone levels equal to a Stage 1 smog alert or an "unhealthy" rating using the Air Quality Index.

The levels of ambient ozone produced by EcoQuest indoor air treatment systems which utilize RCI technology are in the range of 0.01 to 0.05 ppm. Ozone measurements should be made in the room environment, not at the point of ozone production in the unit. Ozone is a highly reactive molecule and quickly reverts back to oxygen in a normal room environment. When tested correctly, EcoQuest technologies are designed to operate well below the California Ambient Air Quality Standard 0f 0.07ppm.

The highest levels of ozone are produced by indoor air cleaning devices that intentionally produce ozone, which are often referred to as "ozone generators". Two other types of air cleaners – ionizers and electrostatic precipitators – may emit ozone as a by-product of their design and function. These usually emit much lower levels of ozone than intentional ozone generators, but some emit ozone at levels of health concern. Mechanical air cleaners that use a physical filter to remove pollutants from the air typically emit very little ozone. Other technologies that may be utilized in an indoor air cleaning device include ultraviolet light and Photocatalytic oxidation, both of which can emit ozone, but usually at low levels.

Indoor air cleaning or air treatment systems that also provide for particulate removal through forms of ionization are not usually referred to as ozone generators. Many of these would not be defined as Electronic Precipitators because of the different ionization technologies employed. To define any indoor air cleaning or air treatment systems that by design produce ozone in addition to particulate removal is inappropriate and may be confusing from a public policy perspective. Certain Photocatalytic Oxidation systems produce very low levels of ozone and these are not of public health concern.

Recent survey results from Piazza *et al*. (2006) found that 14% of California households own one or more air cleaning devices, and 2% own an ozone generator. Of particular concern is that 45% of the households using an ozone generator also had children in the home, and 50% of those households had purchased the air cleaners to help one or more members with allergies or asthma. Additionally, a majority of households indicated that they operate their air cleaner continuously, 24 hours a day throughout the year. Based on

these survey results and studies of air concentrations produced by these devices, well over 500,000 Californians are estimated to be routinely exposed to ozone concentrations above the 8-hour CAAQS of 0.070 ppm due to the use of an ozone generator. Piazza *et al*. also found that another 8% of California households use an air cleaner that may emit ozone as a by-product; thus, the number of persons potentially exposed to unhealthful levels of ozone from their air cleaner is even higher than the 500,000+ persons affected by intentional ozone generators.

There is no solid evidence presented that any of the 500,000 + persons who own indoor air treatment systems are exposed to dangerous levels of ozone. At no point in this Staff Report is there any data on persons harmed by ozone generating Indoor Air Cleaning Devices. If such data exists we request detailed reports on each incident and what permanent heath effects have been experienced.

Ozone is Not Effective at Cleaning the Air

Manufacturers of ozone generators often claim that "safe" levels of ozone can remove indoor air pollutants such as particles, gases, allergens, viruses, odorous compounds, mold, and bacteria. In fact, ozone reacts with some indoor air chemicals to produce significant increases in other pollutants such as formaldehyde and ultrafine particles, which can be harmful to health (Boeniger, 1995; Nazaroff and Weschler, 2004; Hubbard *et al*., 2005). While ozone reduces a few odorous compounds, it simultaneously fatigues the olfactory sense and reduces one's ability to smell odors, essentially masking odors rather than removing them ***(Such a statement has no scientific support. Ozone is an effective deodorizer because it acts as an effective oxidizing agent. A simple test to debunk such a myth would be to rub a slice of onion on the back of both hands. Then take one hand and hold it in front of an ozone air purifier for 2 minutes or less while the other hand is behind your back. Then smell the hand that was held next to the purifier as compared to the hand behind your back. The smell on the hand that was held in front of the purifier will virtually be gone! More on this subject will be discussed later in this document.)*** Ozone is somewhat effective in killing mold and bacteria on building material surfaces, but only at extremely high levels – over 5.0 ppm – and even those levels do not denature or remove microbial residues and spores in building materials (Foarde *et al*., 1997), which can continue to trigger asthma and allergy symptoms. Extensive expert testimony in the successful lawsuit by the Federal Trade Commission against Alpine Air and Living Air, two ozone generator manufacturers, confirmed the almost complete lack of effectiveness of ozone for indoor air treatment (FTC, 2002). More recently, Chen *et al.* (2005**)** confirmed that two ozone generators did not effectively remove volatile organic compounds from a test room, except for limonene, which reacts quickly with ozone to produce formaldehyde, a known human carcinogen and respiratory irritant.

Scientific peer review and published studies have documented (Sergeya Grinshpun, Atin Adhikari, Takeshi Honda, Kiyoun Kim, Mika Toivola, K. S. Ramchanderrao, and Tiina Reponen, Environ. Sci. Technol. 2007, 41, 606-612) that Indoor Air Treatment Systems remove particulates and odors from the air.

Other studies have documented the substantial inactivation of microbiological pathogens, including bacteria, viruses and mold spores in the air and on surfaces in indoor environments (M. T. Ortega, L. J. Franken, P. R. Hatesohl, and J. L. Marsden, Kansas State University, scheduled for publication).

Types of Air Cleaners Covered by This Regulation

This regulation addresses portable air cleaning devices designed for room, whole house, whole floor, and in-vehicle use, and those designed to be carried on one's person. Devices not covered in this regulation include in-duct devices that are an integrated component of a heating, air conditioning and ventilation system, and industrial use air cleaners. Industrial use devices are exempted as long as specified labeling and point-of-purchase requirements are met.

Testing, Labeling and Certification are Required

The proposed regulation would limit the ozone emission concentration from indoor air cleaning devices for sale in California to 0.050 ppm, consistent with the Federal limit for medical devices; require compliance with electrical safety standards and specified labeling requirements; and require certification by ARB. The American National Standards Institute (ANSI) / Underwriters Laboratories, Inc. (UL) Standards 867 and 507 are the test methods that would be used to determine compliance with the requirements of this regulation. Ozone emissions from indoor air cleaners would be determined following the test conditions outlined in the 2007 revision of Section 37 of the ANSI/UL Standard 867. This revision is currently undergoing review through the ANSI standard revision process, but is expected to be finalized and approved in September 2007. Indoor air cleaning devices using only mechanical filtration for pollutant removal would be exempt from the testing requirement for ozone emissions, based on their known *de minimis* ozone emissions, but would still be required to obtain ARB certification by submitting verification of electrical safety certification based on Standard 507 and by following the labeling requirements. Any mechanical air cleaners certified to Standard 507 prior to the enactment of the proposed regulation would be eligible for certification without additional testing.

Any indoor air cleaning device for use in an occupied space, not qualifying for exemption, also would be required to display the proper label on product packaging prior to sale in California. Medical devices would be labeled to comply with Federal law, and State “ARB certified”. Non-medical devices certified by ARB would be required to display a label with text that reads “This air cleaner complies with the Federal ozone emissions limit. ARB certified.” on the product packaging. Air cleaners that qualify for exemption from this regulation would likewise be required to display a specified exemption label on their packaging. Any non-certified air cleaner for non-industrial use in occupied spaces would be required to display an advisory warning stating “Device does not meet California requirements; cannot be shipped to California.” in a prominent place on all Internet webpages, catalog pages and related materials for marketing and sale of the device. All air cleaners sold in California for use in occupied spaces would be required to display the appropriate electrical safety certification or listing mark on the product.

The proposed regulation would apply to any person, manufacturer, distributor, or retailer that manufactures or offers for sale indoor air cleaning devices, for use in occupied spaces, within the State of California. Manufacturers would be responsible for the initial certification of their devices for ozone emissions and electrical safety, and full compliance by the effective manufacture date. The effective manufacture date is proposed for 12 months following the effective date of the regulation, anticipated to be the date of approval by the California Office of Administrative Law. An effective sale date is proposed for 21 months after the effective date of the regulation; then only certified devices could be sold in California. This provision essentially allows distributors and retailers a nine month sell-through period.

Since ozone is a highly reactive compound, testing should be conducted in an environment that allows for ozone to react naturally with biological materials. This natural process moderates the levels of ozone in indoor environments because ozone reverts back to oxygen when it interacts with other compounds. If other compounds are not in the testing environment, ozone will build up to unnatural levels. Testing under “Sterile” conditions does not reflect the dynamic nature of the system. In fact, there is little in the record to explain exactly how the testing revisions came about, other parties’ participation in the UL or testing revision process, what UL did or did not consider, UL commentary, etc. Also, it appears from my understanding of UL 867 that is was specifically designed for Electronic Precipitators that originally were not designed to intentionally produce ozone and therefore the testing protocol, including the 2 inch testing, is not scientifically relevant to newer non-Electronic Precipitator type products and technologies designed to emit low levels of ozone as part of an overall indoor air cleaning or air treatment system. The proposed regulation needs to be modified for revised testing.

Regulation Will Reduce Exposure to Ozone

The proposed regulation would provide significant public health benefits by greatly reducing the exposure of Californians to indoor ozone, especially in households that use indoor air cleaning devices. The proposed regulation would prevent the routine exposure of well over 500,000 Californians to ozone concentrations above the 8-hour CAAQS of 0.070 ppm due to the use of an indoor air cleaning device that emits ozone. Most importantly, many of these Californians are exposed to ozone levels several times greater than the health-based standard; thus their exposure reduction would be substantial. Reduction in ozone exposure would greatly reduce the risk of respiratory symptoms, reduced lung function, and increased airway inflammation and hyperreactivity. The regulation may also reduce asthma exacerbation, school absences, hospitalizations for respiratory disease, and other health impacts associated with ozone exposure above health-based standards. In addition, the reduced levels of indoor ozone would reduce the potential for oxidative damage to indoor materials and furnishings. The reduction of indoor ozone would also reduce exposure to chemical reaction products from ozone with other indoor pollutants, such as formaldehyde, a known human carcinogen.

This assumes that there is a problem in the first place. This has not been established – only assumed. To clarify even further, ozone is proven to reduce formaldehyde. Ozone is used to reduce formaldehyde concentration in travel trailers, a problem recently highlighted by the Katrina disaster.

Regulation is Recommended to Reduce Risk from High Ozone Air Cleaners

During the development of the proposed regulation, several alternatives were considered. These included no action, allowing devices with “occupied” and “unoccupied” settings (“dual use” devices) or use of devices labeled for unoccupied use, and selection of an alternate test method. Taking no action is not an acceptable option because AB 2276 requires ARB to regulate ozone emissions from indoor air cleaning devices, and the health risk posed by some air cleaners is clearly unacceptable. Allowing “dual-use” devices or high-emitting devices labeled for unoccupied space use only is not acceptable as these devices have the potential for very high ozone exposure if not used exactly as instructed, and this approach (written warnings) is essentially the status quo. While other test methods were considered, ARB Staff propose to follow the test methods of ANSI/UL 867 and 507, because this avoids the substantial additional time and resource requirements involved with developing a new test method and utilizes the industry standard that is currently used by most manufacturers. Because testing to the ANSI/UL Standard 867 is already performed by existing third party laboratories, there is no added cost to the State of California to develop the test method or test facility to implement this regulation. The 2007 revision of ANSI/UL Standard 867 is health protective and is consistent with the Federal ozone emissions limit of 0.05 ppm, as mandated by AB 2276.

After evaluating public input and considering several regulatory alternatives, ARB Staff believe that the proposed regulation is necessary and beneficial for the protection of public health. The proposed regulation is both technologically and commercially feasible. Approval of the proposed regulation would greatly reduce the exposure of more than half a million Californians to acceptable levels, especially children and sensitive groups such as those with asthma and other respiratory diseases who commonly purchase air cleaning devices.

Tens of thousands of testimonial letters have been written from satisfied customers including parents of child asthmatics, allergy sufferers, etc., who have used ozone producing air purifiers responsibly for decades. Under the proposed regulations outdated 2 inch stainless steel chamber testing protocol, consumers in California will be denied access to these highly beneficial life-changing devices.

The CA ARB Staff should weigh the public health advantages of the "documented" anti-microbial effects of ozone against the "theoretical" risk of potential over exposure. In the application of any technology, drug, insecticide or other helpful product including oxygen that could be potentially misused, the crucial question always revolves around what is termed as risk-benefit analysis. In medicine for example, this is the daily mantra "above all, do no harm". But every intervention has an attendant risk of some sort. Wise doctors are always weighing the two things in balance. "What if we do this – what's the benefit to the patient or consumer and what is the risk?" On the other hand, "what if we don't do this – what's the cost to the patient or consumer and what is the risk in that case?" This is a very biased regulation that proposes using outdated testing methods - as the State puts it, "to save resources" and only focuses on the downside of 'rare potential' of ozone 'negligent misuse', yet never looks at the positive upside reported by tens of thousands of 'responsible' users.

Aspirin is probably the most widely used drug of all time. It's like a miracle drug with new benefits being discovered almost every few years. Yet, every day aspirin abuse causes serious complications and deaths due to hemorrhaged, anaphylaxis, Reye's Syndrome, ulcer exacerbation and the list goes on. But the benefits of 'responsible' aspirin use are so well established that the risk-benefit analysis works in its favor. And society is aware of inherent risks of 'misuse' yet are giving the freedom to choose and use aspirin responsibly to reap its many benefits.

It's interesting to note that most marketing campaigns that promote pharmaceutical drugs spend more time disclaiming the possible negative side effects, up to and including death, than they do the benefits. Yet targets are being put on safe indoor air treatment systems that 'when tested correctly' produce ozone as part of the process even at low levels < 0.05 ppm that pose no health risk. Moreover provide many important benefits! And even more interesting – Millions of ozone type air purifiers have been sold in the United States and around the world over the past few decades, yet there has never been one single case, where an ozone air cleaner has been definitely linked to any major illness or permanent bodily harm!

Staff's proposal does not fully take into account the changing real world conditions of air quality and surface contamination, including potentially dangerous bacteria, staph, viruses like bird flu, mold, some of which are resistant to current antibiotics and can lead to documented instances of extreme illness, even mortality. To use government regulations to prohibit the introduction and use of helpful products with proven and effective newer technologies where consumers, businesses and health care facilities can provide for their own levels of protection against these contaminants is reckless, shows complete disregard for consumers freedom of choice and would deny the public of many health benefits that government on its own would not be unable to provide to the general public for their protection.

STAFF REPORT

I. Introduction

A. Overview

This Staff Report presents the technical justification and analysis for the proposed regulation of ozone emissions from indoor air cleaning devices (IACD). The Report is part of the Initial Statement of Reasons (ISOR) for the Proposed Regulation Order to adopt Title 17 Sections 94800 to 94810 to the California Code of Regulations. The Proposed Regulation Order is intended to satisfy the requirements of Assembly Bill (AB) 2276 (Pavley, 2006; see Appendix A for complete Bill). The Proposed Regulation Order is provided in Appendix B of this document.

The following information is included in this technical support document:

- A discussion of the process used to develop the proposed regulation, and the associated public outreach efforts.
- A discussion of the technical basis for the proposed regulation.
- A review of the need for indoor ozone emission reductions.
- A description of the proposed regulation.
- An analysis of the potential economic and environmental impacts from the proposed regulation.

B. Regulatory Authority

In 2006, AB 2276 was approved by the California Legislature and signed by Governor Schwarzenegger to address the serious threat to public health posed by the emission of ozone, either intentionally or as a by-product, by IACD. AB 2276 added Article 8, Sections 41985 and 41986 to Chapter 3 of Part 4 of Division 26 of the California Health and Safety Code (HSC).

Section 41986 instructs the Air Resources Board (ARB or Board) to develop and adopt regulations, consistent with Federal law, to protect public health from ozone emitted by IACD, including both medical and non-medical devices, used in occupied spaces. Section 41986 further stipulates that the regulations must include the following elements:

- An emission concentration standard for ozone emissions that is equivalent to the Federal ozone emission concentration limit for IACD.
- Test procedures for manufacturers to utilize to determine ozone emissions from IACD.
- Certification procedures that enable the Board to verify that an IACD meets the emission concentration standard for ozone emissions using the testing procedures adopted by the Board.
- Package labeling requirements that indicate that an IACD is certified as meeting the emission concentration standard for ozone emissions.

AB 2276 also allows a ban on the sale of IACD that exceed the allowable emission concentration standard; procedures for allowing independent laboratories or others to verify products as meeting the standard; an exemption for IACD that emit only *de minimis* levels of ozone due to their design; and any other element the Board deems necessary to protect the public health from emissions of ozone from IACD.

C. Background

1. Ozone Properties and Standards

Ozone is a highly reactive molecule composed of three oxygen atoms. Ozone is a primary component of photochemical smog, and has been recognized and regulated as a serious outdoor pollutant for many years.

Ozone reports cannot only be confusing. But at times can also be misleading, although not necessarily by intention. Smog pollution is by no means synonymous with ozone pollution. Far from it! All the ingredients of smog are harmful in their own right and at high levels, whether it is volatile oxides of nitrogen and sulfur, carbon monoxide, hydrocarbons like benzene and polycyclic aromatics, or all the VOC's that we should learn to fear. Ozone seems like such an easy target, maybe because of its characteristic odor, its simple formula or its ease of measurement. But, by no means, is it the culprit of smog. Unfortunately, the ozone level has become a convenient index of air quality (pollution) and is in widespread use. That's fair, except that it's an indicator of other things too, especially of how much we are polluting the atmosphere!

Ozone is natures purifying agent and without it there would be nothing in our air to effectively oxidize the millions of tons of man made pollution that individuals and industry are dumping in the air each year! But to think that's where "the pollution" is would be a gross deception, bordering on folly. It's

like blaming the messenger more than the message and trying to escape its demands. To change the metaphor, it's like blaming the firefighter for the fire, while the city burns!

Human exposure to ozone can damage the respiratory system. Ozone inflames and irritates respiratory tissues, and can worsen asthmatic symptoms in individuals with asthma. Ozone exposure can produce symptoms such as coughing, chest tightness, and impaired breathing. Elevated exposures have the potential to induce permanent lung damage, and chronic exposure can even increase the risk of premature death (ARB 2005b). Ozone can also damage plants, fabrics, rubber products, and building materials, such as paint and flooring (ARB 2005b). **(*At what level? Even oxygen at high levels is dangerous! These statements are very misleading as in the description of health effects associated with ozone. Unqualified high levels of ozone can be harmful, there's no doubt about that. But one must always qualify any statement about health consequences with some indication of levels of concentration. Failure to do so makes almost anything conceivably dangerous to health, even the indispensable oxygen we breathe, the water we drink and any food we eat. Too much of anything is bad for you! This clearly includes ozone.***

In 2000, a study supported by the California Air Resources Board (under the auspices of the Long-Term Exposure Health Effects Research Program) regarding the effects of air pollution on children's lung function growth determined that "Ozone did not appear to play a major role in the pollution's effects on children's lungs. Instead the offenders were nitrogen dioxide, microscopic particles known as particulate matter, and the acid vapors. All come directly or indirectly from the burning of fossil fuels (the exhaust from automobiles, for example), as well as from emissions from industrial plants and other sources. Many other experts have unjustifiably and incorrectly singled out ozone for criticism for years, perhaps again only because ozone is so easy to measure and too easy to blame.)

To prevent these health and environmental impacts, ozone in the ambient (outdoor) air is currently regulated at both the Federal and California State level. State and Federal ambient air quality standards (AAQS) have been established for ozone, as shown in Table I-1 below. The U.S. Environmental Protection Agency (U.S. EPA) is currently considering revisions to the Federal standard.

If the State and Federal standards are based on "ambient air quality standards", why is the CA ARB's Staff so insistent on using outdated testing methods based on 2 inch testing from the face of the equipment in a stainless steel chamber vs. common sense real world testing of "ambient air"? (in common in living spaces) that include carpeting, drapery, cooking environments, humans, pets, mold, household chemicals, etc.? As previously stated ozone is highly reactive and will cancel itself out when coming in contact with pollutants yet will build up in sterile environments not typical of American homes.

2. Types of Air Cleaning Devices

The indoor air cleaning devices on the market use a variety of technologies to remove unwanted contaminants from users' indoor environments. Some of these technologies emit ozone during their operation. A number of manufacturers market appliances labeled as "air purifiers" or "air cleaners" that intentionally generate ozone; these are often referred to as "ozone generators" (OGs). Current OGs most often use metal plate electrodes or needle electrodes to create electrical discharges that produce ozone, typically in large quantities. Two other types of IACD that may emit ozone as a by-product of their operation, hereafter referred to as by-product (BP) devices, include ionizers and electrostatic precipitators. These devices emit ozone as a by-product of their design, and typically emit much lower levels of ozone than do OGs. Ionizers release electrons into the air, forming ions with molecules in the air which then attract particles to form larger particles that have a greater tendency for deposition. Electrostatic precipitators (ESPs) utilize

an electric corona to charge airborne particles and collect them with charged metal plates of opposite polarity. In addition to the technologies mentioned, IACD may also incorporate an ultraviolet (UV) illumination into their operation. The UV irradiation purportedly reduces the microbial activity of the 'treated or cleaned' air, essentially acting as a biocide. A new emerging technology for IACD is Photocatalytic oxidation (PCO). Photocatalytic oxidation attempts to remove pollutants using UV irradiation in conjunction with a catalytic surface to produce hydroxyl radicals and superoxide ions which react with organic pollutants.

Finally, another group of air cleaners, those that use only pleated fibrous filters or a similar physical barrier type technology, emit little or no ozone, and are not a concern; these are hereafter referred to as mechanical-filtration devices.

The market for portable air cleaning devices advertised for residential use has expanded substantially as public concern over indoor air pollutants has increased. Recent figures indicate that annual national sales of these products have surpassed $400 million (Consumers Union, 2005a). Additionally, national market data indicate the sale of IACD grew by 34% over the five years from 1998 to 2003, and the trend was expected to continue through at least 2008 (The Freedonia Group, 2004). Survey results from Piazza *et al.* (2006) found that two out of every three IACD in California homes were purchased since 2003. Thus, the market for IACD within California is showing rapid growth consistent with this expectation.

This same report shows that a high percentage of the consumers surveyed are aware that their purifiers emit ozone and many state that the air in their homes has improved and as a result those with larger homes even purchased a second purifier!

3. Ozone Concentrations Produced by Air Cleaners

The operation of IACD that produce ozone in the confined spaces of homes and commercial buildings may ***(Regulations should be based on facts, not speculation. The word "may" is a very general term open to unreasonable doubt and lacks true scientific evidence – especially in cases where decisions to ban safe helpful devices are at stake!)*** cause unhealthful ozone exposures, that is, elevated room ozone concentrations above the health-based State and Federal AAQS for ozone. To ensure adequate protection of public health, the ozone emissions from IACD need to be limited, especially considering the observed and expected growth of this industry.

Sources of ozone emissions data for currently available models of IACD include U.S. EPA test reports, a small number of scientific journal articles, manufacturers' product test data (generally not available), and tests of four models by ARB Staff. A test home study by researchers at the U.S. EPA found that an OG could produce indoor ozone levels up to three times the California Ambient Air Quality Standards (CAAQS) of 0.09 ppm averaged over one hour and 0.070 ppm averaged over eight hours (Mason *et al*., 2000). In another study, a number of IACD, including ESPs, ionizers and OGs, were evaluated in representative indoor room environments and found to produce steady-state indoor ozone concentrations as high as 0.650 ppm, which is over seven times the 1-hour CAAQS and over nine times the 8-hour CAAQS (Britigan *et al*., 2006). Measurements within a stainless steel test chamber showed ozone concentrations as high as 1.8 ppm, twenty times the 1-hour CAAQS, from one IACD which has both ESP and ionizer functions (Tung *et al.*, 2005). Ozone emissions as high as 0.389 ppm have been measured from a "personal air purifier" worn by the user near their face (Phillips *et al.*, 1999).

At what distance from the personal air purifier device was the test performed? When testing the level of water in a glass, should you test it coming out of the faucet or once it's in the glass? The average distance that personal purifiers are worn is approximately 10-12 inches below the nose, not 2 inches away. It is important to note that users are generally not sitting still inside of stainless steel chambers for 24 hour periods, instead are moving around in real world environments with lots of air circulation and plenty of organic matter for the ozone to neutralize itself. Furthermore, personal

purifiers do not intentionally produce ozone; instead they use ionization to purify the personal breathing space. Low levels of ozone are a by-product of this process. One particular product manufactured by WEIN Corporation, widely sold under the name Mini-Mate and Fresh Air Buddy, has over 10 peer reviewed studies that show the positive attributes of this technology on cleaning up the air in personal breathing spaces. There are also countless testimonial letters written by satisfied users. Yet here again, not one single case has been documented where a consumer has been permanently harmed by a personal purifier.

Additional measurements of ozone emissions from current model OGs performed by ARB Staff, described in Section IV.D. of this Report, found face emissions and room concentrations of ozone well above 1-hour and 8-hour CAAQS (ARB, 2006a).

***What type of room were the products tested in? Were they real world environments? The EPA has stated that indoor the air is up to 5 times more polluted than outdoor air? In this scenario that means there is plenty of organic matter for ozone to cancel itself out before it can reach high levels*.**

Thus, previous research indicates that ozone emissions from IACD may ***(Do they or don't they? Again, the word "may" leaves reasonable doubt in the world of science and in law, especially, if the study is to be used to deny consumers their freedom of choice in selecting products that are proven to provide substantial health benefits when used as directed)*** elevate room concentrations of ozone above acceptable health values, and thus pose a substantial health risk.

4. Ineffectiveness of Ozone in Cleaning Air

Manufacturers of OGs often claim that "safe" levels of ozone can remove indoor air pollutants such as particles, gases, allergens, viruses, odorous compounds, mold, and bacteria***. (Recent university peer reviewed and published studies support this claim)*** In fact, ozone reacts only with some gases of concern (aromatic hydrocarbons such as benzene) and with terpenes, such as limonene and pinene, and this produces significant increases in other pollutants such as formaldehyde ***(Oxidation is effective at breaking down thousands of chemical compounds typically referred to as VOC's. The "breakdown" process is typically referred to as a cascading process, where other chemical compounds are formed in the process of breaking down the initial compound. It is true that formaldehyde can be formed from certain compounds, but what has not been disclosed in this document is how effective ozone is at breaking down formaldehyde. This cascading process can ultimately take hours or even days but in the end-products of the chemical reactions that occur when ozone reacts with biological compounds are carbon dioxide and water. It should also be noted that when formaldehyde is formed from typical VOC levels, the formaldehyde level is typically well below the WHO safe guideline concentration of 900 mg/lit. Again, quite contrary to this myth, a hallmark of ozone use for purification purposes is the fact that it produces so little by-product that the benefits of responsible ozone use far outweigh any potential risks of misuse. In fact, ozone is essentially an oxidizing/purifying agent, releasing the extra oxygen atom to leave a harmless oxygen molecule behind. Nothing could be more natural and beneficial than that!)*** and ultrafine particles, which can be harmful to health (Boeniger, 1995; Nazaroff and Weschler, 2004; Hubbard *et al*., 2005). While ozone reduces a few odorous compounds, it simultaneously fatigues the olfactory sense and reduces one's ability to smell odors; essentially masking odors rather than removing them. ***(This point is unfounded. Ozone is an effective deodorizer because, as an effective oxidizing agent, it eliminates many odors, especially the organic based odors such as commonly found in the kitchen when cooking. The effect is not in the nose as suggested or the brain, where the true sense of smell is experienced. The effect is rather from chemically changing the noxious chemicals by oxidizing molecules of carbon, hydrogen, sulfur and nitrogen, to odor-free molecules like carbon dioxide and water. Ozone does not mask the odor, it changes or neutralizes it.***

Thousands of testimonial letters have been written from consumers who state the effectiveness of odor removal from things like skunk spraying, cat urine, smoke smell from forest fires, cigarette smoke, smelly locker rooms, etc.. Many insurance agencies hire outside companies who use ozone to clean up the smell after certain residential and commercial fires. Hotels across the country use ozone to clean up cigarette smoke and vomit odors from rooms. Many car dealerships and auto dealers use ozone to remove cigarette and other odors from cars. Even the Pentagon wrote a letter to EcoQuest International after the 911 attacks stating the dramatic difference that donated ozone air purifiers made in cleaning up smells after the terrorist attacks. The American Red Cross wrote letters to EcoQuest International after recent California wild fires praising the effects that donated purifiers had on smoke odors. Such a statement is clearly inaccurate.) Ozone is somewhat effective in killing mold and bacteria on building material surfaces, but only at extremely high levels – over 5.0 ppm ***(Again, recent university peer reviewed and published studies state the complete opposite and clearly demonstrate the effectiveness of ozone at low levels)*** – and even those levels do not denature or remove microbial residues and spores in building materials (Foarde *et al*., 1997). This leaves them available to trigger asthma and allergy symptoms

Again, thousands of letters from satisfied consumers, including asthma and allergy sufferers state that they have been helped by responsible use of ozone type purifiers, yet not one incident has been documented where anyone has ever been permanently harmed by misusing their purifier.

Ozone treatment is recognized by scientists as an effective means of killing microorganisms for purifying water, but not as a means of cleaning indoor air. Extensive expert testimony in the successful lawsuit by the federal government against Alpine Air and Living Air, two OG manufacturers, confirmed the almost complete lack of effectiveness of ozone for indoor air treatment (FTC, 2002). More recently, Chen *et al.* (2005) confirmed that two OGs did not effectively remove volatile organic compounds from a test room, except for limonene, which reacts quickly with ozone to produce formaldehyde, a known human carcinogen and respiratory irritant***. (The "non issue" of formaldehyde has already been addressed above. Regarding the statement that ozone is not recognized by scientists as an effective means of cleaning indoor air is a misleading biased claim that suggests ALL scientists believe this, is far from the truth! Many scientists the world around know and understand the many health benefits that can be obtained from responsible ozone use. Several scientists have submitted comment to the ARB saying the same. Again, recent university peer reviewed and published studies in themselves completely debunk this biased assessment of the efficacy of indoor air cleaners. Furthermore, there are numerous other studies and countless consumer testimonies that document the benefits of ozone in cleaning up indoor air.)***

5. Californians' Use of Air Cleaners

Recent survey results from 2,019 California households showed that a total of 14% of California households currently own an air cleaner or have owned one within the past five years (Piazza *et al*., 2006). Intentional OGs were reported in 2% of California households, potentially exposing 282,000 households, or 828,000 persons, to unhealthful levels of ozone. About 8% of California households use an air cleaner that may emit ozone as a by-product; thus, the number of persons potentially exposed is much higher. Of particular concern is that 45% of the households containing an OG also had children in the home. Children are a particularly vulnerable group because of the proportionally higher dose of ozone that they inhale due to their breathing rates and activity patterns, their developing lungs, and other factors. Additionally, the survey showed that 50% of the households that own air cleaners purchased them to help relieve allergies or asthma in one or more household members, and about 30% of households that own air cleaners own two or more units. The survey data also showed that most air cleaner owners operate their IACD year-round, 24 hours a

day; thus there is the potential for significant indoor ozone exposure within the California population, including children.

The ARB Staff should more closely evaluate why so many Californians rely on indoor air technologies that use ozone. Clearly most of these consumers of these products are realizing substantial benefits or the products would not be in use and moreover return rates would be astronomical. If this were the case manufacturers would be out of business in short fashion. Instead, demand for these types of purifiers is on the rise! This study never surfaced the most important fact of all. How many people have been permanently hurt by irresponsibly using their purifier? Providing that ozone levels are controlled, which can be achieved by utilizing the latest state-of-the-art equipment on the market, there is no risk to consumers, including children. In contrary many health benefits can be experienced by breathing cleaner air through the use of indoor ozone purifiers. Levels with air treatment systems in operation typically have lower measurable ozone levels than would be found outside!

II. Development of Proposed Regulation

A. Public Outreach and Participation
B. Comment Period and Board Hearing
C. Evaluation of Alternatives
D. Potential Regulation Benefits

The proposed regulation would provide significant public health benefits by greatly reducing the exposure of Californians to indoor ozone. ***(Does this also include 'protecting' the thousands of extremely satisfied consumers who claim that their health has dramatically improved since having an ozone type air purifier in their home?)*** The proposed regulation is estimated to prevent the routine exposure of well over 500,000 Californians to ozone concentrations above the 8-hour CAAQS of 0.070 ppm due to the use of an indoor air cleaning device that emits ozone. Most importantly, many of these Californians are exposed to ozone levels several times greater than the health-based standard. ***(How many "actual homes" have had their ambient ozone levels tested vs. testing that was done 2 inches away from the face of the purifiers in sanitary stainless steel chambers? And how many Californians have been identified as being permanently harmed by responsibly using a purifier that uses low levels of ozone to purify the air?)***

This reduction in ozone exposure would greatly reduce the risk of adverse health impacts in a substantial fraction of the persons exposed, including reduced pulmonary function and increased lung inflammation and airway hyperresponsiveness to allergens. Young children and people with asthma would especially benefit from the avoided exposure. Exposure to ozone above the CAAQS has also been associated with increased risk of premature death, hospitalization for respiratory disease, emergency room visits for asthma for children, asthma onset and exacerbation, school absences, and minor restricted activity days for adults (ARB, 2005b). This proposed regulation may also reduce such health impacts in people living and working in buildings where ozone generating air cleaning devices are used. In addition, the reduced levels of indoor ozone would reduce the potential for oxidative damage to indoor materials and furnishings (ARB 2005b). This reduction of indoor ozone exposures would also reduce exposure to chemical reaction by-products from ozone. Indoor chemical reactions of ozone with certain substances from cleaning products and building materials are known to produce pollutants of health concern. Specifically, using products that contained terpenes such as pinene and limonene – the fragrance components of pine and citrus oils – in rooms where ozone is present results in the production of formaldehyde and ultrafine particles, which can potentially harm human health (Nazaroff and Weschler, 2004; Destaillats *et al*., 2006; Singer *et al*., 2006).

III. Technical Basis for Proposed Regulation

IV. Need for Emissions Reductions

A. Health Effects of Ozone

The health effects resulting from exposure to ozone have been examined in detail and are summarized in an ARB Staff report entitled *Review of the California Ambient Air Quality Standard for Ozone* (ARB, 2005b). The following provides an overview of the Staff report findings.

Scientific studies have shown that exposure to ozone can result in increased respiratory symptoms (such as cough, wheeze, difficulty breathing, and chest tightness) reduced lung function, increased airway hyperreactivity, and increased airway inflammation. Moreover, exposure to ozone is associated with premature death, hospitalization for respiratory causes, increased school absences, and increased minor restricted activity days for adults (ARB, 2005b). As required by HSC 39605, special consideration needs to be made for infants and children in assessing the effects of ozone exposure. By virtue of their higher breathing rates, children are likely to inhale larger total doses of ozone than the general population.

Furthermore, two studies have shown evidence of lower lung function in young adults raised in high ozone areas (Galizia & Kinney, 1999; Kunzli *et al.*, 1997). There is also evidence that children who play three or more sports may be at higher risk of developing asthma if they also live in high ozone communities (McConnell *et al.*, 2002).

Ozone in the ambient outdoor environment is currently a regulated pollutant at both the Federal and California State level. In 2006, a new State ozone standard of 0.070 ppm (8-hour average) became effective, and the 1-hour standard of 0.090 ppm was retained. Because current outdoor ambient levels of ozone are sometimes above the State standards, significant health benefits would result by attaining the standards throughout California. Specifically the number of adverse health effects avoided each year is estimated to be:

- 630 premature deaths (310 - 950, probable range)
- 4200 hospitalizations due to respiratory diseases (2400 - 5800, 95% confidence interval
- [CI])
- 4.7 million illness-related school absences for children 5 to 17 years of age (1,200,000 -
- 8,600,000, 95% CI)
- 3.1 million minor restricted activity days for adults over 18 years of age (1,300,000 –
- 5,000,000, 95% CI)

Some other health effects that would be avoided to some extent include exacerbation of asthma, asthma attacks, and the onset of asthma; however, the reduction in these effects cannot yet be quantified.

These statistics do not address the low levels of ozone produced by controlled indoor air treatment systems. They relate to outdoor air pollution in general and the fact that ozone is an easily measurable indicator of air pollution. They have little bearing on the regulation of indoor air treatment systems in general. Another important fact to consider is that ozone is being targeted here as the 'only' contributing factor to the above conditions when in reality there are many thousands of contributing pollutants in outdoor air that individually at high levels and more so cumulatively at high levels are responsible for these conditions and more.

B. Controlled Exposure Studies

While no epidemiology study to date has focused on the health effects of indoor ozone exposures, there is a body of controlled exposures studies that can be used to estimate the proportion of the general population that might experience adverse health outcomes from indoor exposures. These studies are based on known ozone concentrations, breathing rates, and exposure durations. Because of this, and because estimates of

indoor activity levels and exposure durations are available, we can use these studies to make rough estimates of the proportion of people exposed to ozone from operation of ozone-emitting air cleaners who might experience adverse health outcomes for several endpoints.

1. Lung Function
A number of studies have investigated lung function responses to ozone The most frequently reported measure of lung function is functional expiratory volume in one second (FEV1: the volume of air one can exhale in one second). This test is the most reproducible of the various measures of lung function, and consequently is the most frequently reported. The ARB Staff report on the ozone standard concluded that a reduction in FEV1 of greater than 10% was an unacceptable level of response, and should be protected against (ARB, 2005b), and this convention is applied to the present analysis.

Results of studies of two-hour duration during which the subjects alternated periods of light to moderate exercise (comparable to walking at three miles per hour or less) are shown in Table IV-1 (Gliner *et al.*, 1983; McDonnell *et al.*, 1983; Kulle *et al.*, 1985; Horvath *et al.*, 1981, 1986; Drechsler-Parks *et al.*, 1987, 1990; Bedi *et al.*, 1988; Hazucha *et al.*, 1996).

The fact that Staff recognizes that there have been no epidemiological studies on the effects of indoor ozone exposure would suggest that any regulation is premature.

Table IV-1. Percentage of Subjects Having Decreases in FEV1 Greater Than 10% and 20% with 2-Hour Ozone Exposures (Healthy Subjects)

These results suggest that significant numbers of people are likely to experience a decrease in lung function with two-hour or greater exposure to indoor ozone concentrations as low as 0.18 ppm. This concentration is well below the concentrations measured in ARB's chamber study of ozone generators ***(Chamber studies are not representative of real world living conditions!)*** (ARB, 2006a) and the Mason *et al.* (2000) chamber and test home study, which each ranged up to 0.300 ppm or higher.

Results of lung function studies of four hours duration that included alternating periods of light to moderate exercise (comparable to walking at three miles per hour or less) are summarized in Table IV-2 (Balmes *et al.*, 1996; Gong *et al.*, 1997).

Table IV-2. Percentage of Subjects Having Decreases in FEV1 Greater Than 10% and 20% with 4-Hour Ozone Exposures

The results at 0.24 ppm reported in Table IV-2 are based on one small study (N=9 chronic obstructive pulmonary disorder (COPD) patients; N=10 healthy), which may not be representative of the broader population. However, the findings at 0.22 ppm, based on a larger group of subjects (N=56), suggest that a significant proportion of the population is likely to experience FEV1 decreases of concern with a 4-hour exposure at this level.

Table IV-3 summarizes the reduction in FEV1 for ozone exposures of 6.6 to 8 hours duration. These studies included moderate exercise of 50 minutes per hour, with a 30 minute break at the mid-point of the exposure (Folinsbee *et al.*, 1988; Horvath *et al.*, 1991; Peden *et al.*, 1997; Kehrl *et al.*, 1999; Jenkins *et al.*, 1999). While relevant in terms of exposure duration, it is likely that few people exercise to this extent indoors, likely overstating risks to a more sedentary population.

Table IV-3. Percentage of Subjects Having Decreases in FEV1 with 6.6 to 8-Hour Exposures

The results provided in Table IV-3 suggest that a significant fraction of the population is likely to experience large decreases in lung function if they undergo 6.6- to 8-hour exposures to ozone concentrations as low as 0.08 ppm.

2. Pulmonary Inflammation

Pulmonary (lung + airway) inflammation is another common effect of ozone exposure. Ozone is a strong oxidant that can damage the tissues lining the airways, causing tissue injury and inflammation. Inflammation is the initial sign of tissue damage. Repeated ozone-induced injury and repair cycles lead to permanent damage to, and remodeling of, lung structure. Table IV-4 presents the percentage of healthy and asthmatic subjects who showed evidence for pulmonary inflammation following exposures to ozone for the concentrations and durations indicated (Seltzer *et al.*, 1986; Koren *et al.*, 1989; Graham & Koren, 1990; Devlin *et al.*, 1996; Peden *et al.*, 1997; Krishna *et al.*, 1997; Nightingale *et al.*, 2000; Newson *et al.*, 2000; Vaggagini *et al.*, 2001). In each case, subjects alternated periods of light to moderate exercise and rest during exposure.

Table IV-4. Percentage of Subjects Having Evidence of Pulmonary Inflammation Following Ozone Exposure

The results in Table IV-4 suggest that the majority of people exposed for 2 to 7.6 hours to ozone at concentrations greater than 0.16 ppm will develop evidence of pulmonary inflammation.

3. Airway Hyperresponsiveness

Airway hyperresponsiveness refers to the tendency for the muscle cells in the larger airways to contract in response to irritants (i.e., methacholine) or allergens. Research has shown that increased airway hyperresponsiveness is a characteristic of asthma, and that aggravation of hyperresponsiveness is associated with asthma exacerbation. Some nonasthmatic individuals also have hyperreactive airways. In addition, several studies showed that allergic asthmatics tend to have increased responses to allergen challenge following exposure to ozone, compared to that following exposure to filtered air. Table IV-5 shows the percentage of subjects who experienced increased airway hyperreactivity from methacholine or allergen challenge after controlled exposure to ozone (Seltzer *et al.*, 1986; Folinsbee *et al.*, 1988; Hiltermann *et al.*, 1995; Ball *et al.*, 1996; Jorres *et al.*, 1996; Kehrl *et al.*, 1999; Foster *et al.*, 2000).

Table IV-5. Percentage of Subjects Having Increased Airway Hyperreactivity in Response to Methacholine or Allergen Challenge Following Ozone Exposure

As can be seen from Table IV-5, a large proportion of healthy and asthmatic subjects are likely to experience increased responses to irritants or allergens after ozone exposure.

4. Uncertainties

Controlled human exposure studies are typically from one to eight hours in duration, and are typically designed to simulate some form of outdoor activity. Because of this, most study designs include periods of light to moderate exercise, which may not be fully analogous to the longer, semi-chronic exposures likely in homes that operate ozone generating air cleaners. The controlled human exposure studies used in this analysis employed exercise that was comparable to walking at two to three miles per hour for 15 or 20 minute periods, alternated with rest periods of the same length for two to four hours, or for 50 minutes per hour for 6.6 to 8 hours. People are not typically completely at rest while indoors, except while sleeping; adults commonly engage in various types of housework and indoor exercise programs, and children engage in moderately active play. However, the breathing rates employed in the controlled human exposure studies may overestimate those typical of indoor activities to the extent that indoor activity is more episodic, less intense, or of shorter duration. Lung function and symptoms responses to ozone exposure plateau at levels primarily related to ozone dose rate (concentration x breathing rate). Consequently, the effect prevalence's

described above for two to eight hour exposures would likely be overestimates for populations who have lower breathing rates during indoor exposures. Exposure duration plays a role in response magnitude, although it is of less importance than either concentration or ventilation rate in driving effects. It should also be noted that the information in Tables IV-1 to IV-5 above is based on sample sizes that vary from as few as 8 subjects, to as many as 93 individuals. It is unknown to what extent the subjects studied are representative of the population as a whole. Because of this, the proportions of affected people shown in Tables IV-1 to IV-5 should be regarded as approximations. Finally, it should also be noted that purchasers of ozone generating air cleaners who find that the units adversely affect their breathing may stop using them. Piazza *et al.* (2006) found 29% of air cleaner owners had stopped using their air cleaner, but for a variety of reasons.

(None of this information is relevant to the issue of "indoor" exposure to very low levels of ozone produced by controlled indoor air treatment systems. This section speculates at best and attempts to draw conclusions from information relating to "outdoor" air pollution, again where thousands of dangerous pollutants and gases also exist. Individually and more so cumulatively virtually ALL of these pollutants and gases at high levels could exasperate asthmatic and allergy type symptoms, not just high levels of ozone as found on a smoggy day. Interestingly, these other pollutants and gases are never mentioned in the Report – instead high levels of ozone are singled out as the culprit)!

C. Physical and Chemical Properties

Ozone at ambient temperature and pressure is a pale blue, reactive gas comprised of three oxygen atoms, and thus is also referred to as triatomic oxygen. The gas has a pungent odor, with an odor threshold of approximately 0.010 – 0.030 ppm (NLM, 2007). ***(Unlike carbon monoxide that is clear, odorless and can fill a room undetected and kill people, ozone has an obvious pungent, irritating 'bleaching' odor at HIGH levels and can even be visible to the eye. Because of these built in "safety features", if levels were to ever reach unsafe amounts consumers would be able to see a pale blue color in the air as well as detect a strong unpleasant "pungent" odor. If either of these conditions were to occur from potential misuse of an air purifier, common sense would alert the consumer to either turn their purifier down or turn it off well before any damage to health could occur. In summary, if ozone were to ever reach dangerously high levels it would be very unpleasant and obvious that the purifier is up to high! Both of these conditions (pungent odor and blue gas) could be listed as "warnings" in the owner's manual for the product or listed on the outside of the unit in a conspicuous manner. In contrary, when ozone type purifiers are set correctly a consumer can expect a sweet pleasant scent of 'clean, fresh air' as experienced after a thunderstorm or high in the mountains on a sunny day.)***

Ozone is both corrosive and a strong oxidant, and can damage vegetation and a variety of materials including fabrics and building materials, such as paint, walls and flooring (ARB 2005b). ***(True, but only at HIGH levels over an extended period of time. But at low levels as produced by ozone type air purifiers there is no measurable damage to these materials.)*** Occasionally ozone may also be referred to as "super oxygen" and "activated oxygen" by some IACD manufacturers; however these are incorrect, misleading terms.

Ozone is primarily found in the stratosphere of the earth's atmosphere, commonly referred to as the 'ozone layer' (U.S. EPA, 2007). The stratosphere is located between approximately 6-30 miles above the earth's surface, with the ozone layer found between 10-25 miles above the surface. The ozone layer absorbs selective bands of radiation from the sun preventing it from reaching the earth's surface. UV radiation in band C (<280 nm) is completely removed by the ozone layer, and most of band B (280-320 nm) is also absorbed. The shielding from UV-B is beneficial as it has been shown to contribute to various types of skin cancer.

Additional atmospheric ozone (~10%) is found in the troposphere (U.S. EPA, 2007). This tropospheric ozone is commonly referred to as "ground-level ozone" and is in the air that people breathe. Tropospheric ozone in California is primarily produced via photochemical reactions of volatile organic compounds (VOCs) and

nitrogen oxides (NOx). Ambient ground-level ozone concentrations exhibit a diurnal pattern as its formation reactions require the energy input from sunlight. Thus, ozone levels typically increase during the mid-day and decrease at night.

However, transport of polluted air masses can result in high ozone concentrations at night. Ozone concentrations also exhibit seasonal variation with the length of day and night. Outdoor ozone levels are typically the highest in the summer, on hot, stagnant, and cloud-free days. Ozone can also be produced via electrical discharge, electrochemical and UV radiation, of which electrical discharge is the most efficient. Ozone production via electrical discharge, and possibly UV radiation, are of concern to IACD where ozone production may be either intentional or result as a by-product of operation.

(Ozone is also produced by lightning and has a natural cleansing effect on the outdoor environment when this occurs. This has no bearing on the very low levels of ozone produced by controlled indoor air treatment systems.)

D. Measured Ozone Emissions

In 2005, ARB staff evaluated several models of OGs to identify current emissions levels and to assess potential ozone exposure resulting from their use (ARB, 2006a). Room ozone concentration tests were conducted in a small room furnished with a desk and chair, under temperature, humidity, and air exchange conditions common in homes. ***(This is not representative of a common home – common homes have fans, carpeting, drapery and substantial organic matter that could include: cooking odors, first and second hand tobacco smoke and its odors, hairspray, cologne, perfume, pet dander, mold, mildew, bacteria, human residue including dead skin and hair from virtually every person who has entered the room, fecal matter and urine expelled into the air from toilet flushing, viruses, chemical off gassing from garbage cans and from every piece of furniture, glue, paint, candles, paper products, clothing dye, air fresheners, detergents, furniture polish and other dangerous household cleaning products including ammonia, oven cleaners, bleach, etc..***

This is congruent with the EPA's and American Lung Associations own statements:

> ***"Indoor Air Pollution is up to 5 Times Worse Than outdoor air" EPA.***
>
> ***"Indoor air pollution is America's Number One Environmental Health Concern" – EPA***
>
> ***"50% of all illness is caused by indoor air pollution." – EPA***
>
> ***"Indoor air pollution is wide spread. You are more likely to get sick from pollution in your home and office than from pollution in the air outside." – The American Lung Association***
>
> ***It is interesting to note in this last statement by the Lung Association states that indoor air is more dangerous than outdoor air yet one of their primary solutions to purifying the air indoors is to open up the windows and let in outside air which contains ozone. The question here is, what component is it in the outdoor air that they want us to let in to purify the air indoors? If ozone is such a culprit, why would they want us to open up the window and let in outside air where supposed high levels of ozone are found? On a separate note, what option would a person have if they live in the desert where hot temperatures prohibit opening windows?***

In summary, without the use of and effective particulate removal system and safe oxidizer such as a purifier that utilizes and controls ozone levels to help oxidize these pollutants, they will build up to toxic levels leaving our lungs and bodies to become air purifiers - overwhelming our immune systems and in turn leaving us susceptible to many chronic degenerative diseases up to and including death.

Proper 'real world' consideration should be exercised when developing testing protocols for purifiers that use ozone, as virtually all contaminants react with ozone - cancelling the ozone out allowing for safe ambient ozone levels to be maintained. Said another way, as powerful an oxidizing agent as ozone is, the remarkable property is that it quickly oxidizes dangerous organic matter and decomposes to a nontoxic, environmentally safe material – breathable oxygen!

Here again, the crucial question revolves around risk-benefit analysis. It is clear that risk of not using safe levels of ozone indoors to help oxidize these harmful contaminates, far outweighs the very minimal if any risk of using it!)

The IACD were operated according to manufacturers' instructions. Prior to the room concentration tests, measurements were made at 2, 6, 12, and 24 inches from the face of each device to locate the major output stream for each and identify the range of emissions in preparation for the room concentration tests. The test methods used are described further in Appendix C. ***(Responsible manufacturers instructions would never recommend that a unit be put in a small room or stainless steel chamber with only a chair and a table with the purifier feature turned on high, nor would they instruct consumers to sit next to the purifier 2, 6, 12 or even 24 inches from the product at any time. Instead, responsible manufacturers suggest that the purifier be set 5 to 6 feet off the ground on a book shelf or book case aimed at the center of the room with the purifier setting set at the appropriate room setting size and the fan turned up to provide additional air circulation.)***

Room concentration results for OGs, shown in Table IV-6, show that all of the models tested produce room concentrations that exceed health-based standards and can pose a serious risk to health. The Biozone® 500, the Prozone® Whole House, and the Prozone® Compact produced room concentrations that substantially exceed both the CAAQS of 0.09 ppm, 1-hour average, and 0.070 ppm, 8-hour average, for ozone. They also would exceed the U.S. FDA standard of 0.05 ppm that applies to medical devices (devices for which the manufacturers make health-related claims). Additionally, the Alpine Air XL-15 / LA Lightning Air RA 2500 unit exceeded the 1-hour and 8-hour CAAQS, as well as the FDA standard when set at a medium setting (ozone output for a 1,000 square foot area). This unit was not tested at its highest setting, but has been shown in other studies (e.g., Mason *et al*., 2000) to produce room levels over 0.300 ppm at its highest settings.

The Prozone® Whole House unit produced the highest room concentrations measured when operated in the continuous mode – over 0.400 ppm, more than four times the 1-hour CAAQS, and over six times the 8-hour CAAQS. Although the continuous mode is designed for an unoccupied home with greater volume than the test room in this study, consumers could naively operate the unit in this mode when their home is occupied, which would result in extremely high ozone exposures. Additionally, when operated for 15 minutes per hour as recommended by the manufacturer for occupied spaces, the Prozone® still produced unhealthy ozone levels: concentrations reached 0.09 ppm within 7 minutes, and the maximum 60-minute average was 0.119 ppm, well above both CAAQS.

The Prozone® unit has no adjustments and no clear guidelines for proper use. This highlights the need for a reasonable test protocol, but under Staffs proposed unrealistic 2 inch steel chamber testing procedures all purification devices which intentionally generate ozone would fail. Again, testing should be done using "real world" living conditions.

Table IV-6. Room Concentrations Measured from Intentional Ozone Generators

Results of the face emissions tests for the four OGs are presented in Table IV-7. Of particular concern are the high ozone emission concentrations measured, several of which exceeded 1 ppm at the 2 and 6 inch measurement distances. Three OG tests yielded ozone concentration in excess of 0.360 ppm at a distance of 24 inches, which is over 4 times the 1- hour CAAQS. The elevated ozone concentrations observed at the measurement distances warrant public health protection to limit near-source ozone exposures from IACD, such as use near a bed or baby crib.

Indoor air treatment systems are designed to reach a natural equilibrium in a typical room environment with organic matter present. The placement of a 'high' ozone emission system 2-6 inches or even 24 inches from a baby crib would never be recommended by any responsible manufacture of ozone air purifiers. A controlled and properly placed system would result with ozone levels between 0.01 and 0.05 ppm.

E. Estimated Pre-regulation Exposure to Ozone

The estimated residential concentrations of ozone resulting from the current use of portable indoor air cleaners in California are shown in Table IV-8, along with the estimated number of persons that experience each level of exposure. In total, well over 500,000 Californians are estimated to be routinely exposed to ozone concentrations above the 8-hour CAAQS of 0.070 ppm due to the use of an indoor air cleaning device that emits ozone. The supporting bases for this estimate are discussed below.

Table IV-7. Face Test Results for Intentional Ozone Generator Air Cleaners

1. Indoor Ozone Concentrations: Ozone Generators

Table IV-8, Column B shows three ranges of ozone exposure for households using ozone generators (0.201-0.400, 0.101-0.200, and 0-0.100 ppm). These estimates are based on the following;

A. In a study of ozone generators in a single-family test home, Mason *et al.* (2000) reported in-home concentrations of 0.038-0.310 ppm for a larger, whole-house OG unit, and 0.018- 0.065 ppm for a smaller OG unit. Various device settings, room locations, and central air system settings were tested. The air exchange rate of the home was similar to that typically found in newer and weatherized homes, but was not as low as some new homes.

B. In a study of ozone generators in a test room, Phillips *et al*. (ARB, 2006a), reported indoor ozone concentrations of 0.088-0.435 ppm for larger OG units, and 0.096-0.149 ppm for smaller OG units. Note that maximum ozone settings were not tested in some cases, and that devices with even higher ozone emission rates are on the market. The in-home concentration values for ozone are reasonable estimates of average 8-hour exposures in California for several reasons:

- Current OG models by Alpine Air / EcoQuest have maximum settings that can produce even Higher ozone levels than the settings used in the study by Mason *et al.* (2000) ***(True but these higher settings are by design. However, responsible manufacturers such as EcoQuest clearly state in their instruction manuals as well as on the face of the unit that these 'away mode' features are to only be used in 'unoccupied spaces'. The purpose of these higher settings is allow consumers the option to more quickly clean up odors and other organic matter including, cigarette smoke odors, mold, mildew, bacteria, etc., while the space is 'unoccupied'. As an additional safety feature most purifiers that offer these 'away mode' features (signifies to the user this feature is to be used only when people are "away" from the purifier in un-occupied space) also have built in timers that allow consumers to set the purifier for a specific amount of time on***

high or away mode. After the timer runs its course the purifier automatically reverts back to a lower setting for occupied spaces. This allows consumers to know exactly how long to stay out of the room while the purifier is turned on high or away mode for specific purposes.)

- California adults on average spend 62% of their 24-hour day in their home, and children spend 76% of their time in their home. About 64-72% of California households with ozone emitting air cleaners in a survey of 2,019 households reported operating their air cleaners continuously, 24 hours a day, 7 days a week (Piazza *et al*., 2006). This indicates that an 8-hour exposure duration may be a conservative assumption for most air cleaner users.
- 28-40% of California households with OG or BP devices have two or more such devices in their home (Piazza *et al.*, 2006), indicating that there may be multiple ozone emission sources in many homes (thus producing higher ozone concentrations) and that the residents may often be in close proximity to one of those ozone emission sources.

These are worst case estimates of exposure and do not represent the actual measurable ozone levels that are produced by controlled indoor air treatment systems in real world environments and applications.

Table IV-8. Estimated Population Exposure to Ozone from Indoor Air Cleaners

2. Indoor Ozone Concentrations: By-Product Devices
The same approach as above for OGs was used for By-Product air cleaners, as shown n the lower part of Table IV-8. The pre-regulation ozone exposure estimates are based on reported results from room and test chamber studies of a number of different models studied by Chen *et al.* (2005, 2006), Mullen *et al.* (2005), Britigan *et al.* (2005), and Consumers Union (2005a,b). The fractions of the households exposed at the three different levels of ozone are based on the Statewide Survey Data of Piazza *et al*. (2006), and an estimated distribution of model types with higher emissions. The two highest categories of ozone emissions, 0.081-0.120 ppm and 0.021-0.080 ppm, are estimated to account for 5 and 15% of the BP category respectively, for a total of 20%. The remaining 80% of the BP devices are estimated to emit very low amounts of ozone.

3. Percent of Homes in Exposure Category Table IV-8, Column C shows the estimated fractions of homes likely to experience the ozone exposure ranges discussed above. Data are not currently available on the distribution of air cleaners by ozone emission rate and type, or on the distribution of ozone output settings used across homes. Therefore, a reasonable assumption was made that the size of the ozone generator and emission rate would correlate well with the size of the room where it is used. The size of the room where the device was used was also considered in estimating the indoor ozone exposures.

The Statewide Survey of 2,019 households in California discussed earlier (see Background) also provides information on room sizes where air cleaners are used. Piazza *et al.* (2006) indicates that about 50% of the OGs are used in larger rooms such as the living room.

Presumably these are the larger, whole-house units with the highest emission rates, or devices designed for large rooms, and would be operated at the higher settings. As a conservative estimate, it is assumed that some of these households operate the device at lower settings or have higher air exchange rates and larger home volumes than the 1,200 square foot test home in Mason *et al.* (2000), and that household members would not typically spend a full 8 hours near the device. These assumptions lead Staff to estimate that only about 25% of these households experience the highest range of ozone exposures.

The survey results showed that about 30% of OGs are used in medium sized rooms such as the master bedroom and the family room, and about 20% are used in other types of rooms. Presumably these units would be either smaller units with low or medium emission rates, or the larger whole house units used at low

or medium settings. This suggests that, out of the remaining 75% of the households, the medium- and low-ozone exposure categories comprise about 45% and 30% respectively. Note that, depending on the ozone output setting and the tightness of the room, the resultant ozone concentration in the room could still be in the high range. Also, 28% of the households with OGs reported having two or more air cleaners (Piazza *et al.*, 2006), which could increase indoor ozone levels even further. Thus, 45% and 30% are reasonable, or perhaps even conservative, estimates for the medium- and low-ozone exposure categories, respectively. In addition, the distribution of sales prices for OGs in California (Piazza *et al.*, 2006) was examined as an indicator of the size of the ozone generators, and this yielded a similar distribution as above.

4. Number of Persons Exposed

The estimates of the number of persons exposed are shown in Table IV-8, Column D. These estimates are based largely on the results of the statewide survey by Piazza *et al*. (2006). That survey found that 282,000 households (2.28%) comprised of 828,000 persons, reported owning an ozone generator within the past five years. About 78% of the households reported current use of an OG, yielding an estimated 650,000 persons currently exposed to ozone from OGs, as shown in Column D of Table IV-8. ***(Again, thousands of consumers have written letters stating that they have been helped by their purifier. Not one case has been documented where anyone has been permanently harmed by an ozone air purifier)***

This value was then multiplied by the percent of homes in each category (Column C), to yield the exposed population for each category of exposure level and air cleaner, as shown in Column D. Of the 650,000 subtotal for owners of ozone generators, 160,000 persons are estimated to be exposed to indoor ozone concentrations of 0.201-0.400 ppm over 8 hours or more, and 290,000 persons are estimated to be exposed to indoor ozone concentrations of 0.101-0.200 ppm over 8 hours or more.

The same approach was used to estimate the number of persons exposed to ozone from BPs, except that the Statewide Survey reported that 7.83% of households, comprised of 2,800,000 persons, owned BPs within the past five years. Accounting for the 78% current use rate, this yields an estimated subtotal of 2,200,000 persons currently using BPs in their homes.

Of these persons, 111,000 persons are estimated to be exposed to indoor ozone concentrations of 0.081-0.120 ppm over 8 hours or more, and 330,000 persons are estimated to be exposed to indoor ozone concentrations of 0.051-0.080 ppm over 8 hours or more.

In summary, well over 500,000 Californians are estimated to be routinely exposed to ozone concentrations above the 8-hour CAAQS of 0.070 ppm due to the use of an indoor air cleaning device that emits ozone. Most importantly, many of these Californians are exposed to ozone levels several times greater than the health-based standard.

Again, these are worst case estimates of exposure and do not represent the actual measurable ozone levels that are produced by controlled indoor air treatment systems in real world environments and applications.

In conclusion - Ozone is a Paradox. Webster's' Collegiate Dictionary defines a paradox as "a person, thing or situation, exhibiting an apparently contradictory nature" and that is certainly true of ozone. The ordinary man in the street has probably learned through the media and popular misinformation that ozone is only something toxic in the air and has no health benefits at all. It is supposed to be a real health hazard and major pollutant to be avoided. In fact, when most people think of air pollution, they often think of ozone levels and relate the two together. Therefore, just the concept of ozone as a purifying agent would be an apparent contradiction in terms. But the contradiction is only 'apparent' for there is in practice solid scientific evidence that supports there is no safer, effective and more

convenient oxidizing agent (acting alone) to purify polluted air, than this very natural element from nature.

V. Proposed Regulation

A. Applicability (Section 94800)
B. Definitions (Section 94801)
C. Emission Standard (Section 94802)
D. Exclusions and Exemptions (Section 94803)
E. Certification Requirements (Section 94804)
F. Test Method (Section 94805)

Section 94805 details the test methods proposed to be used for verification of compliance with the ozone emission standard described in Section 94802. For the purpose of compliance with the requirements of this regulation it is necessary to examine only one model of IACD within a model group, as defined in Section 94801, if a model group exists, to verify compliance with the test methods. The allowance for IACD model groups will limit unnecessary testing of IACD that may have non-performance related differences such as aesthetic modifications (i.e., color), several different brand names, or other similar cosmetic differences. ANSI/UL Standards 867 and 507 are the test methods that would be used to determine compliance with the requirements of this regulation. Both are available from http://www.comm-2000.com. The ANSI/UL Standard 867 will be used to evaluate both the ozone emissions and electrical safety for all applicable IACD. Indoor air cleaning devices that are verified as mechanical-filtration only devices will be evaluated for electrical safety using ANSI/UL Standard 507, or any ANSI/UL Standard that addresses electrical safety for mechanical filtration air cleaners that succeeds Standard 507, and ozone emissions testing would not be required for certification. Inclusion of the electrical safety testing requirement for compliance with this regulation would provide protection to consumers by ensuring that any IACD design modifications to meet the ozone emissions limit do not compromise the integrity and fire safety of the device.

Ozone emissions from IACD would be determined following the test conditions outlined in the 2007 revision to Section 37 of ANSI/UL Standard 867. As the standard revision process is taking place in parallel to the development of this regulation, the following discussion of the ozone test method is based on the revision draft released for public comment on June 22, 2007.

While changes to the released draft are expected, ARB Staff anticipate that they will be small with little impact on the determined ozone emission. A copy of the June 22, 2007 Standard revision is provided in Appendix E. The revisions to Section 37 of Standard 867 are proposed by UL to provide clarification of the ozone emissions test protocol described in Section 37 in order to minimize variability among laboratories and to address uncertainties in the original language of Section 37. Briefly this test measures the ozone emissions of the IACD at a distance of 2 inches from the device over a period of 24 hours within a test chamber. ARB Staff feel that by following the revised Section 37 and the 2 inch measurement location, any potential for extremely high near-source ozone exposures from IACD, as discussed in Section IV.D., would be minimized for the assured protection of public health. This is very important as several IACD examined by ARB Staff emitted ozone in excess of 1 ppm at this distance, illustrating the substantial risk for extremely high near-source exposure levels. Since the emission test is conducted for a period of 24 hours, any ozone accumulation in the room will be ascertained in a manner consistent with the FDA regulation.

There are several important changes specified in the proposed revision of Section 37 of ANSI/UL Standard 867. A notable change to the ozone emission test procedure is the manner in which the background ozone concentration is determined. Accurate determination of the background ozone levels is essential. Previously, the pre- and post-test background measurements were averaged and then subtracted from the highest concentration measured during the IACD device test to calculate the ozone emission concentration. The previous language of Section 37 allowed for varied interpretation regarding when the pre- and post-test

background measurements were to be performed, potentially allowing high ozone emitting IACD to pass the 0.050 ppm emission restriction (Niu *et al*., 2001a,b; Chen *et al.*, 2005; Siegel, 2005).

The revised Section 37 now stipulates that the background measurement is to be performed in the test chamber immediately prior to the start of the IACD emission testing. Additionally, the proposed revision stipulates that none of the background measurements can exceed 0. 05 ppm. These additional specifications for the background measurements should prevent high ozone emitting devices from meeting the 0.050 ppm emission limit due to differences in interpretation of test details.

Other changes in the proposed Section 37 revision pertain to the test chamber. The majority of the changes to the test chamber were aimed to reduce variability in the ozone emissions determined by different laboratories. Test chambers may be constructed from stainless steel or any other non-porous and non-reactive material provided the chamber is able to attain the specified performance characteristics. These performance characteristics include verifying an ozone half-life of 16 ± 1 minutes, an air exchange rate between 0–0.35 ACH, and an air supply system capable of providing particulate-free, VOC-free, and ozone-free air. By tightening the specifications of the test chamber, the proposed revisions to Section 37 would substantially reduce inter-laboratory variability which is essential to avoid certified devices later failing a compliance test if tested by another laboratory.

Other notable revisions include the following:

- If the ozone emission of the first device exceeds 0.030 ppm, compliance with the emissions concentration limit will be verified by testing a second unit of the same model.
- The device will be operated for a 72 hour run-in period prior to emissions testing.
- The average of five consecutive measurements taken 60 seconds apart must not exceed 0.050 ppm.
- The maximum ozone emission location would be determined and used for the location of the monitoring inlet.
- Devices with multiple operation settings would be tested on each setting, or for continuous dials, on the high, medium and low settings.
- IACD containing ozone-monitoring circuitry must meet the emission limit with and without the circuitry engaged, unless its reliability has been demonstrated under specified tests.

For compliance with this regulation testing to determine the ozone emissions and electrical safety of IACD must be performed by an independent laboratory currently recognized as a Nationally Recognized Testing Laboratory (NRTL) by the U.S. OSHA. The laboratory must have NRTL status to complete the ANSI/UL Standard 507 and revised Standard 867 testing in their entirety. Such a NRTL may also utilize a Program #2 independent laboratory per the March 9, 1995 OSHA Federal Register Notice 60: 12980-12985 for Section 37 ozone testing required in this regulation. Prior to performing testing for this regulation, laboratories must also pass an ARB audit. The ARB audit would include an initial paper evaluation of the laboratories' Standard Operating Procedures (SOPs). Once the laboratories' SOPs are deemed acceptable, ARB Staff may conduct an on-site inspection to verify the test chamber and instrumentation configurations, as well as to observe the successful attainment of the test conditions specified in the proposed revisions to Standard 867. Upon satisfactory completion of the ARB audit, laboratories may begin testing for certification submission.

Proposed Test Protocol for Air Purification Devices Which Intentionally Generate Ozone

UL 867 has been chosen by the Air Resource Board staff as the protocol for all Air Purification equipment to test for ozone emissions. Whether the current version of UL 867 is selected, or some revised version apparently being shepherded through the private UL process by ARB staff, UL 867 is inadequate and not the best test protocol under any revision,

By way of background, UL 867 was originally designed decades ago for testing electrical appliances to insure the "Incidental Ozone" output created by their electrical motors is not excessive. Many electrical appliances including copiers, any equipment with electrical motors, and even traditional electrostatic precipitators (electronic air filters with a particulate collection device that removes particles from a flowing gas, such as air, using the force of an induced electrostatic charge) can produce excessive incidental ozone if improperly designed. UL 867 was never intended to be the single standard for testing air purification equipment also designed to intentionally emit ozone through any technology, old or new.

To summarize UL 867: compliance is checked by placing the equipment in a sealed room (walls covered with polyethylene) measuring approximately 8'x12'x10'. The unit is placed in the center of the room on a table approximately 2.5' above the floor. The pick up tube for the ozone measuring equipment is placed approximately 2" in front of the unit and located directly in the "worst case" air flow. The unit being tested is adjusted to provide the maximum ozone level (maximum output with lowest air flow setting). Ozone measurements are recorded over a 24 hour period. The standard requires that at no time can the ozone measurement exceed 0.05 ppm. A simple visualization of this process amply demonstrates that UL 867 solely was intended for incidental ozone emissions.

To bring things into perspective, using UL 867 for determining acceptability of air purification equipment which also intentionally generates ozone would be equivalent to developing a test protocol for a radiant wall heater which specifies a maximum temperature of 80 degrees F measured 2" from the face of the heater. Meeting such a protocol would render the heater virtually useless.

Further, any standard for evaluating ozone emissions from indoor air cleaning devices should recognize the universally accepted scientific reality of the highly reactive nature of ozone and the fact that ozone will readily react with organic compounds in a room environment. The end-products of the chemical reactions that occur when ozone reacts with biological compounds are oxygen and water. When ozone reacts with mold, bacteria, viruses or volatile organic compounds (VOC's), the microorganism is oxidized and inactivated. In any typical indoor environment, there is ample biological material to facilitate the rapid conversion of ozone to oxygen. Therefore, testing should not be done in a "sterile" environment, but rather under conditions that represents the conditions that exist in a typical indoor environment.

Using UL 867 as the default standard to test new air cleaning products and technologies designed to also produce low levels of safe ozone over the past decade has resulted in even a very small amount of otherwise safe levels of ozone to build up to levels that exceeded the Federal 0.05 ppm limit. In fact, we submit that this default use of UL867 has contributed to the current confusion over the safety of newer air purifiers that compete with the more traditional electrostatic precipitators and HEPA filters endorsed by the California Lung Association.

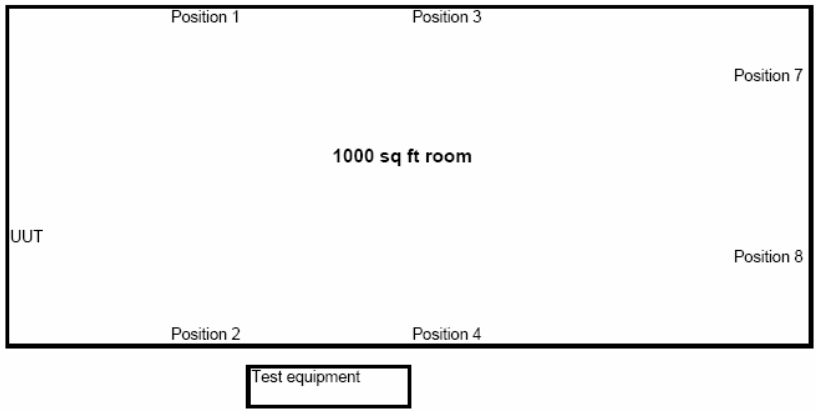
To summarize this important point, reliance on UL 867 has helped to fuel the current debate over air cleaners that emit ozone, because creating ozone in a sealed environment for testing purposes, without having anything in that environment to react with will allow even a very small amount of ozone to build to levels that will exceed the 0.05 ppm limit, thereby guaranteeing the air purifier or cleaner to fail the UL 867 testing protocol.

A More Realistic Test Protocol

We submit that a more realistic test should be devised and approved by the Board that assesses the true functionality of ozone producing air purifiers in a real world environment, unlike the UL 867. Not

all environments are created equal nor will any two be the same, but a conservative approach can be taken to include basic household and/or office furnishings including carpet, drapes, and a humidity level of 50% to better represent the organic compounds (loading) in a room environment.

In order to assess ozone creation vs. dissipation, effectively insuring the air purifier does not create more ozone than can be dissipated in a natural environment, the unit should be tested in an environment representative of where it is to be used. A realistic approach would be to place the unit in a "furnished" room, sized according to the rated output for the unit to be tested. For this assessment, a volumetric approach to measurement should be taken:



In most cases, manufacturers of air purification devices which include technology that intentionally generates ozone, include the ability to scale the ozone output based upon the area or volume of the space being treated. For certification purposes, two tests should be performed:

1. ***Lowest setting for the smallest space the purifier is designed to go into, and***
2. ***Highest setting for the largest space the purifier is designed to go into.***

Appropriate consumer labeling should be required to inform the user of proper operation of the device and minimum space requirements in square footage for safe operation while the space is occupied.

The diagram above shows a typical setup for a 1000 sq ft room. For this test, the unit is placed along a wall of a furnished room (as outlined above), on a table top approximately 6' above the floor. An ozone measurement device (preferably capable of measuring a minimum of 6 locations simultaneously) is setup outside the chamber and connected to sampling tubes located at positions1 and 2 which represents 250sqft of area, positions 3 and 4 which represents 500 sq ft of area and positions 7 and 8 which represents 1000 sq ft of area (note: positions 5 and 6 which would normally represent 750 sq ft of area have been omitted for this test, but could also be measured if so desired). The Unit Under Test (UUT) is configured such that the worst case scenario is represented (Ozone concentration set to match room size and fan set to lowest speed) and powered on. Ozone measurements are recorded at each position for a 24 hr period and compared to the following three criteria:

1. ***<u>Average Ozone Concentration</u> may not exceed .05 ppm. The average concentration is defined as the average of positions 1 thru 6 over the 24 hr period, and this value shall not exceed the average concentration limit of 0.05 ppm.***

2. ***Maximum 8-hour Ozone Exposure*** *may not exceed .08 ppm. The EPA guidelines reflect an 8 – hour Permissible Exposure Level of .08 ppm over any 8 hr period. For the ozone exposure test, the ozone concentration should be measured at each of the six measurement locations and the ozone concentration at any of these locations cannot exceed the EPA's 0.08ppm limit for any 8 hr period nor can it exceed a level of 0.1ppm at any time.*
3. ***Maximum Instantaneous Ozone Exposure*** *may not exceed 0.10 ppm. The EPA guidelines reflect a maximum ozone exposure level at any time of 0.10 ppm. For the maximum ozone exposure test, the ozone concentration should be measured at each of the six measurement locations and the ozone concentration at any of these locations cannot exceed the EPA's limit of 0.10 ppm at any time.*

EcoQuest International is prepared to work with the Board and interested parties to help implement this or similar alternative test protocol.

G. Labeling and Safety Mark Requirements (Section 94806)
H. Notice to Distributors, Retailers, and Sellers (Section 94807)
I. Recordkeeping Requirements (Section 94808)
J. Rejection, Revocation, Recall, and Penalties (Section 94809)
K. Severability (Section 94810)

VI. Economic Impacts