Actions to Address Indoor Ozone Generators

California
Air Resources Board

May 25, 2006

Thank you, Ms. Witherspoon, and good morning, Dr. Sawyer and members of the Board. Thank you for this opportunity to update you on ozone generators.

Introduction

- Background
- ARB Tests of Ozone Generators
- Portable Air Cleaner Survey
- Outreach Activities
- Activities of Other Groups
- Next Steps

Today I will first provide a brief background on this problem. Then I will discuss the results of our tests of ozone generators and update you on our statewide survey of portable air cleaner usage and our outreach activities. I will also summarize the related activities of other groups. Finally, I will discuss the next steps that are planned.

Background

- Ozone generators are a serious health concern
  - Intentional emission of ozone
  - Misleading claims for ozone
- January 2005: Health Update to Board
  - EPA study: > 300 ppb ozone in home
  - Exceedance of health-based standards
  - Ineffective in removing indoor air pollutants
  - Aggressively marketed via mail and the Internet
  - Federal and state efforts ineffective; FDA limit of 50 ppb not enforced
  - Regulatory authority in California is lacking

Ozone generators are a serious public health concern because they can emit large amounts of ozone in enclosed spaces. Ozone generators are portable appliances that are designed to intentionally emit ozone. They are marketed as so-called "air purifiers," often with misleading claims about ozone's effectiveness or toxicity.

Some other popular types of portable air cleaners such as ionizers and electrostatic precipitators also emit ozone, but as a by-product of their design, rather than as an intentional product, and generally at lower emission rates. In this update, we are focusing only on ozone generators, that is, those devices that purposely emit ozone.

In January 2005, we presented a Health Update to you on ozone generators. We highlighted a study by EPA researchers who found that an ozone generator could produce over 300 parts per billion, or ppb, of ozone inside a test home. This level of ozone exceeds our health-based California Ambient Air Quality Standards. Studies have shown that much higher ozone concentrations are needed to effectively kill microbial contamination on indoor surfaces, and that ozone is ineffective at removing indoor air pollutants. Ozone generators are not marketed in retail stores, but rather via the mail, the Internet, and direct distributors.

Federal agencies and a few states have taken actions such as lawsuits and public health warnings, but these have had little effect on the problem of ozone generators. The federal Food and Drug Administration, or FDA, has an ozone limit of 50 ppb for air cleaners marketed with medical or health claims, but they rarely enforce this regulation. The Underwriters Laboratory, or UL, also uses a 50 ppb limit for their air cleaner testing.

In California, regulatory authority to address ozone generators is lacking.

ARB Tests of Ozone Generators

- 4 models tested ($190 - $495 each)
  - Alpine Air XL-15 / Lightning Air RA 2500
  - Biozone® 500
  - Prozone® Whole House
  - Prozone® Compact
- Room concentrations measured
- Emission rates measured

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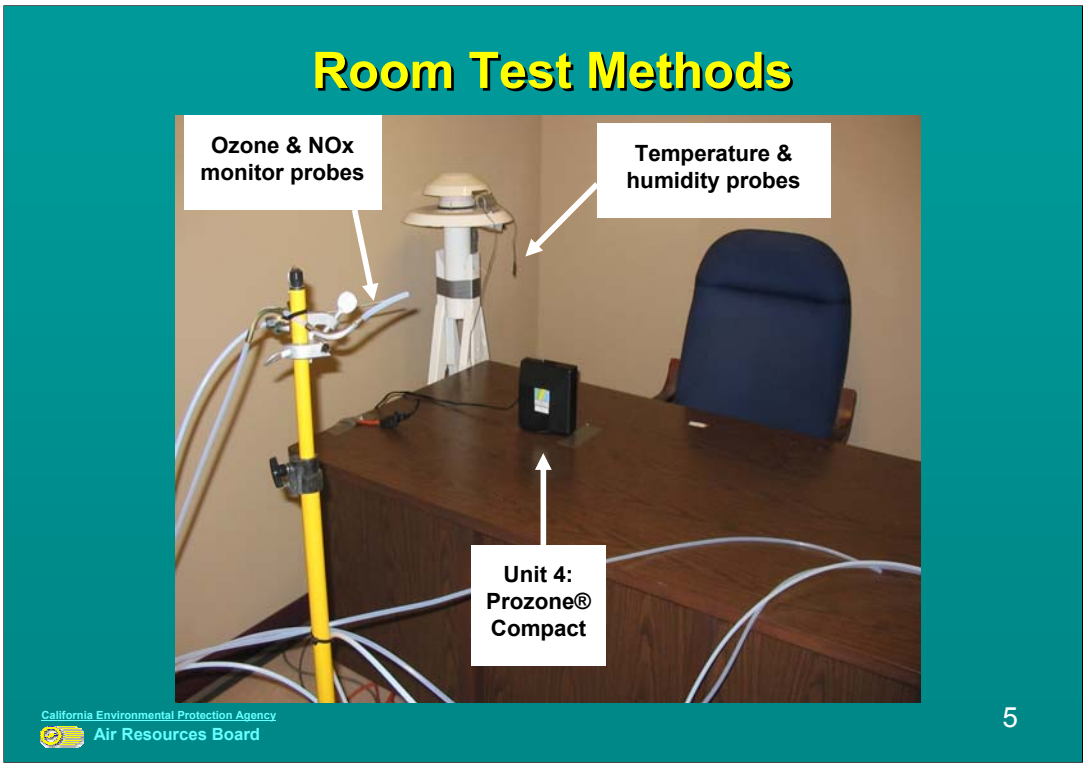
Now, I will move on to our test results. We worked closely with staff from our Monitoring and Laboratory Division, who tested four models of ozone generators.

The 4 models tested were the Alpine Air XL-15 (also known as the Lightning Air RA 2500), the Biozone 500, the Prozone Whole House model, and the Prozone Compact model. These models were selected because they were widely advertised in California or on the web, and are intended for use in occupied spaces. You can see these models displayed on the table behind me.

We measured both the room concentrations produced by these models, and their direct emission rates of ozone.

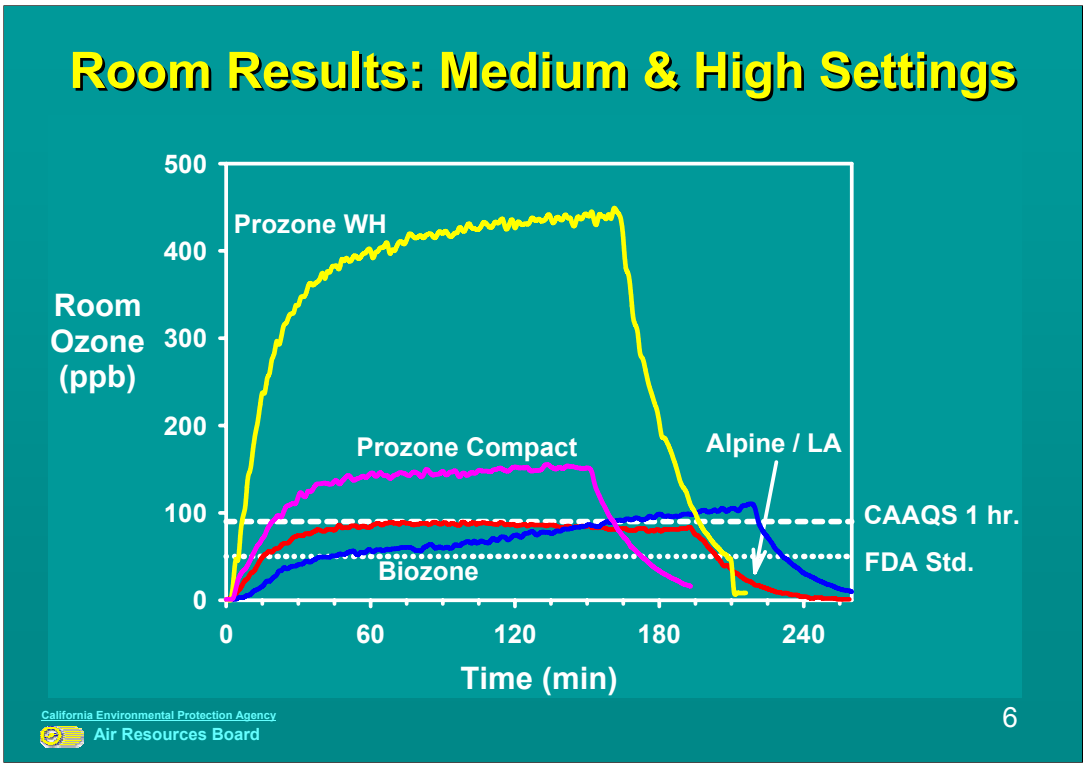


This photo shows the set-up for the room concentration tests. To simulate conditions in a small bedroom or home office, we tested the ozone generators in an 88 square foot room furnished with a desk and upholstered chair. The room has a linoleum floor, and the walls and ceiling are painted wallboard.

The ozone generator was placed on the desktop near the center of the room. The probes for the ozone monitor, nitrogen oxide monitor, and the temperature and humidity sensors were placed three feet from the ozone generator. Background ozone concentrations in the adjoining room were measured during the testing, and were relatively low, ranging from one to twelve ppb during the tests.

The test room is not served by a mechanical air ventilation system. We measured the indoor-outdoor air exchange rate of the room and found that the rates before and during the ozone generator tests remained fairly stable at 0.25 to 0.28 air changes per hour. These rates are in the lower range of home air change rates, but would be common in homes with closed windows and doors.

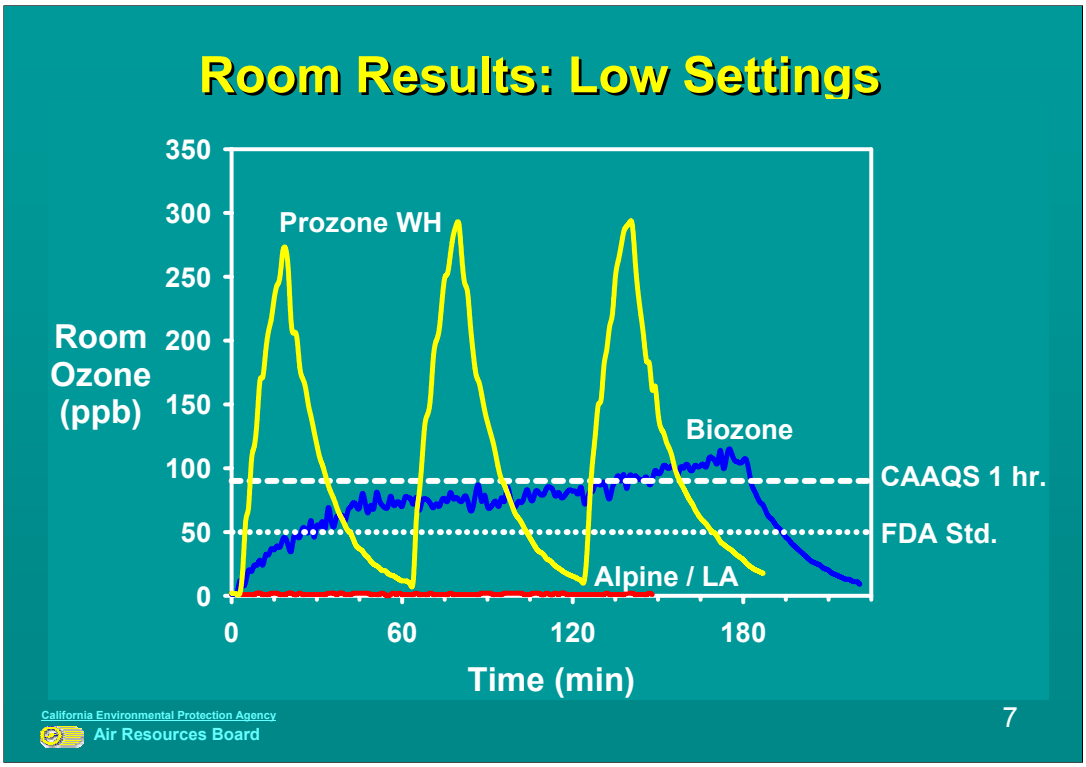
We tested the ozone generators at low-ozone settings, and at high or medium ozone settings, as the device's controls allowed. We operated the devices according to the manufacturer's instructions.



This graph shows the results of the room tests of the four models at medium and high settings for ozone output. The left axis shows the room ozone concentration in parts per billion, or ppb. The bottom axis shows the time in minutes since the ozone generator was turned on in the closed room. The dashed horizontal lines near the bottom of the graphic show the one hour California Ambient Air Quality Standard (CAAQS) of 90 ppb and the FDA and UL limits of 50 ppb.

The ozone generators were operated until the room ozone concentrations leveled off, or for about three hours, whichever came first. For example, the yellow line shows the highest ozone levels measured in the study. These are from the Prozone Whole House unit when operated on its continuous setting. This shows that the room concentration increased very rapidly when the device was turned on at zero minutes. The ozone levels reached 400 ppb in about 60 minutes, and dropped quickly when the unit was turned off at 180 minutes, or 3 hours. The continuous, maximum setting used in this test is recommended only for periods when the home is unoccupied.

As shown by the yellow and dark pink lines on the graph, the Prozone Whole House and the Prozone Compact units exceeded the one-hour state standard and the FDA limit by a wide margin. The Biozone unit, when operated at a high fan speed, also exceeded these levels, as shown by the blue line. The Alpine Air unit, shown by the red line, exceeded the FDA limit and reached the one hour standard, when operated at its medium setting. We would expect even higher room ozone levels if we had tested the Alpine unit at one of its higher settings.



This graph shows the results of the room tests when the air cleaners were operated at low settings for ozone output. The Prozone Whole House unit, shown by the yellow line, was operated on its lowest timer setting, which is at 15 minutes of operation per hour. This intermittent mode is the recommended setting for an occupied home. It produced a peak ozone level of 291 ppb, and as you can see, produced room concentrations well above both 50 and 90 ppb for a good portion of the time.

The Biozone unit, as shown by the blue line, exceeded 50 and 90 ppb when operated with the fan set at a low speed. Fan speed is the only setting than can be adjusted on this model – the ozone output is the same at both speeds.

The Alpine Air unit, when operated at an “ozonator” setting of 100 square feet, the lowest setting, did not appear to produce any ozone – the room concentration was similar to background concentration.

The Prozone Compact only has an on-off switch. It could not be operated at a low setting, so it is not included in this graph.

Room Tests: Time to Reach 90 ppb Ozone

Manufacturer & Model	Ozone Output Setting	Time to Reach 90 ppb Ozone (level of 1-hr CAAQS)
Alpine Air XL-15 / Lightning Air RA 2500	Medium	68 minutes *
Biozone® 500	Low fan	135 minutes
Prozone® Whole House	Intermittent	7 minutes
Prozone® Compact B	On	20 minutes

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* Maximum was 89 ppb ± 2 ppb

This chart highlights some of the information shown in the previous graphs, namely, how quickly each model reached 90 ppb, the level of the one-hour California air quality standard. These results were obtained when the units were operated at settings recommended for occupied spaces.

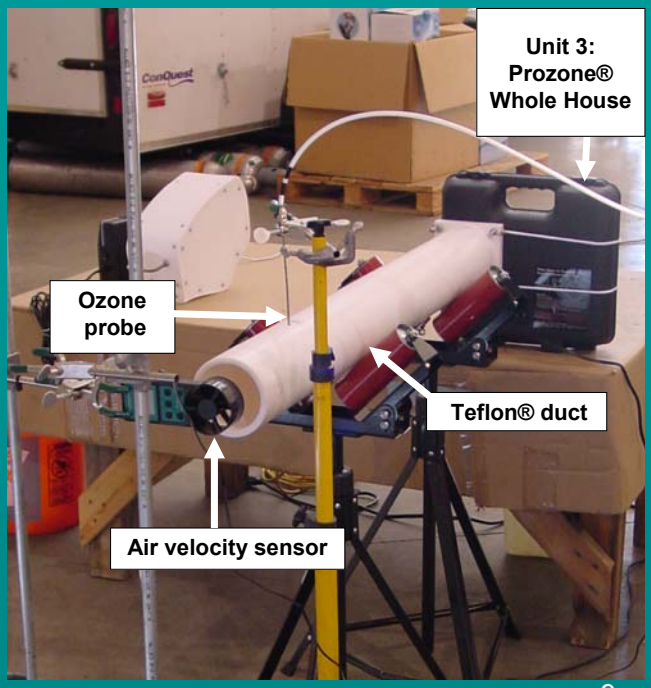
As shown in the right column, the Prozone Whole House model produced room levels of 90 ppb in just 7 minutes, although it was on its intermittent, or lowest, setting. The Prozone Compact model produced 90 ppb in 20 minutes. For the other two models, it took about one to two hours to reach 90 ppb. The Alpine unit produced a maximum of 89 ppb, but considering the precision of the measurements, this is essentially equal to 90 ppb.

The test methods used by the FDA and the Underwriters Laboratory for certain types of air cleaners differ somewhat from the method we used, but based on our results, we believe that the devices we tested would not meet their 50 ppb limits.

Also, we concur with their 50 ppb limits for air cleaners. During California's warmer months, many locations have elevated outdoor ozone levels that increase levels indoors, and the emissions from air cleaners would add to existing levels of ozone indoors.

Emission Rate Tests

- Results consistent with room test results and previous studies



We also tested the ozone emission rates of the four models of ozone generators. The units were operated at settings that were generally the same as those for the room tests.

As shown in this photograph, a Teflon duct (the long white tube in the photo) was attached to the blower fan outlet from the ozone generator.

The ozone emission rate was measured by inserting the ozone probe into the duct at a standard distance downstream. The average concentration of ozone in a cross-section of the duct and the average air velocity in the duct were used to calculate the emission rate for ozone.

The results of our emission tests were consistent with the results for the room tests. That is, the higher room concentrations were produced by the ozone generator models and settings that had the higher emission rates. The results were also consistent with those from the few previous studies available.

ARB Tests: Conclusions

- All four ozone generators can produce room ozone concentrations above health-based air quality standards.
- The measured emission rates are consistent with the room test results.
- These devices are not safe to operate in occupied spaces.

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Based on the room and emission tests just described, we have concluded the following:

•First, all four ozone generators produced room ozone levels at or above the California health-based air quality standard of 90 ppb, and above the FDA limit of 50 ppb. The Prozone models produce indoor ozone levels that would trigger smog alerts.

•Next, the measured emission rates were consistent with the room test results and with previous studies.

•Finally, these devices are not safe to operate in occupied spaces. Because people tend to operate their air cleaners for long periods – sometimes continuously throughout the day and night – it is clear that occupants would experience prolonged exposure to ozone at unhealthy levels when using ozone generators such as those we tested. Nonetheless, manufacturers market these devices to vulnerable groups such as persons with asthma and other respiratory conditions, and families with children.

Portable Air Cleaner Survey

- Objectives
  - Percent of CA households using ozone generators
  - How often and how long portable air cleaners are used
  - Reasons for purchase
- Telephone survey by UC Berkeley
  - Statewide, random sample
  - Interview 1,800 households
- Results expected this Fall

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Now I would like to update you on our other related activities.

As you may recall, we recently funded a statewide survey on portable air cleaners. The objectives of this survey are to determine the percent of California households that are using ozone generators, how often and how long portable air cleaners are used in homes, and the reasons people are purchasing these air cleaners.

To answer these questions, we have contracted with the UC Berkeley Survey Research Center to conduct a telephone survey. Households will be randomly selected from across the state. The researchers will make more than 10,000 calls and interview approximately 1,800 households.

This information will help us to assess the potential impact of ozone generators on public health. We expect the survey results this Fall.

Ozone Generator Outreach

- Proactive effort to educate professionals and the public
- Presentations to key groups:
  - Local air districts, local health officers
  - Medical, dental, and veterinary groups
  - Building and environmental organizations
  - Others
- Ozone Generator Fact Sheet
- Updated list of ozone generators: many new models

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We have also increased our efforts to make Californians aware of the problem of ozone generators. Although thousands of people have visited our website or contacted us directly for information about ozone generators, many more people are unaware of the health risks. Therefore, we are making a proactive effort to educate key professional groups and the public.

We are contacting key groups that can help disseminate this information, including local air districts and local health officers, the other groups shown on the slide, and others such as allergy and asthma groups and the American Association of Retired Persons. We have developed a slide presentation to use when contacting these groups.

In addition, we are distributing our new Ozone Generator Fact Sheet, and you should have a copy of that in your packet.

We will continue to update our website, which has an updated list of ozone generators currently on the market. Since our last update to the Board, the number of ozone generators on our list has doubled. We have included the updated list of ozone generators in your copies of the fact sheet. We expect these devices to continue to proliferate unless a major change occurs.

These photos illustrate a few examples of some new models of ozone generators on the market. Unlike many of the earlier models, which typically were large and “boxy” in form, these devices are now available in a wide variety of shapes and sizes, for a variety of creative uses.

The models shown here, beginning in the top row, from left to right, include two desktop models, the ”USB Air Purifier with Ozone” on the left, which is powered by a computer USB port, and the “Moonland UFO Desktop Ozone Purifier.”

We will pass the Moonland device to you, but it is not turned on. Note that it also has a packet that releases a lemon fragrance. Recent research funded by ARB and others shows that when such fragrance compounds are combined with ozone, harmful reaction products such as formaldehyde and ultrafine particles are produced. So with models like this one, one would be exposed not only to increased levels of ozone, but also increased levels of formaldehyde and ultrafine particles.

Other models shown here include one designed to fit inside shoes to deodorize them. Another model is an optical mouse for use with desktop computers, and two models are designed for use inside vehicles.

We have not found any ozone emission data for these models. However, many of these small units, such as the USB units, are designed to be used in close proximity to the user, and could produce unhealthful ozone levels in the user’s breathing zone.

Related Activities of Other Groups

- AB 2276, Pavley: regulatory authority to ARB
- Attorney General: ARB requested review
- U.S. Consumer Product Safety Commission: consultant review of literature
- Underwriters Laboratory: reviewing industry test method
- Consumer Reports: tested effectiveness and ozone emissions; two articles

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Other groups have recently focused on ozone generators as well. Assembly Bill 2276 by Assemblywoman Pavley would require ARB to develop regulations to address ozone generators. The bill is now being considered by the Senate.

As we discussed in our last update, we had also asked the Attorney General's Office to review our legal options for addressing ozone generators. While a lawsuit might well be successful, it may be ineffective at stopping manufacturers of ozone generators, based on the experience of the Federal Trade Commission in suing Alpine Air. This is because manufacturers could easily avoid the lawsuit's effect by such simple acts as changing their names, corporate status, or product claims. The AG's office has stated support for the Pavley bill.

The U.S. Consumer Product Safety Commission has authority to regulate consumer products. To help decide whether action is needed regarding ozone generators, the CPSC has hired a consultant to review the literature on ozone emissions from air cleaners. However, strong action is not expected.

The Underwriters Laboratory is currently reviewing their standard test method for measuring ozone emissions from electronic air cleaners. Not all manufacturers use this method, and the test method has some technical limitations. However, UL anticipates an improved method within the next year. ARB staff are serving on UL's ad hoc committee to develop an improved test method.

And finally, *Consumer Reports* magazine published two articles in 2005 that have greatly increased awareness about the effectiveness of air cleaners and their ozone emissions. We were able to post one of their articles on our website, and will be posting the second article soon.

Next Steps

- Follow proposed legislation
- Send letters to FDA & CPSC
- Continue outreach efforts
- Complete air cleaner survey
- Continue participating in UL effort to revise industry test standard
- Update Board

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What are the next steps to prevent this unnecessary exposure to ozone? First, we plan to continue following proposed legislation, such as AB 2276 by Pavley.

Next. we will send letters to the Food and Drug Administration and the Consumer Product Safety Commission, to encourage further action on their part.

We will continue with our proactive outreach efforts with key target groups, and complete the survey on portable air cleaners. We also will continue to participate in the UL effort to revise their air cleaner test method.

And finally, we plan to present another update to you when we have substantial progress to report.

Thank you for your attention. We would be happy to answer any questions you may have.