TESTIMONY OF GRAY ROBERTSON
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BEFORE THE SUBCOMMITTEE ON AVIATION
U.S. HOUSE COMMITTEE ON PUBLIC WORKS
AND TRANSPORTATION
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Mr. Chairman, members of the subcommittee, thank you for allowing me to address your hearing today concerning smoking restrictions on commercial airliners.

My name is Gray Robertson, and I am president and founder of ACVA Atlantic Inc. of Fairfax, Virginia. In 1981, my partner and I established ACVA Atlantic Inc. to address a growing concern by the public and private sectors regarding indoor air quality. We were the first such organization in this country to specialize in the analysis, diagnosis and treatment of indoor air pollution, also known as "sick building syndrome." We apply an interdisciplinary approach to air quality that combines the skills of microbiology, chemistry and engineering.

To date, ACVA Atlantic has studied more than 60 million square feet -- some 400 buildings -- of commercial and government property in this country and abroad. Our clients in the public and private sectors have included the General Services Administration (including a survey of the Longworth House Office Building, in which several committee members have offices), the U.S. Department of Health and Human Services, the

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Architect of the Capitol, the U.S. Supreme Court, several state governments, The Oliver T. Carr Company, The John Akridge Company, Lehndorff USA Group, Johns Hopkins Hospital, the John F. Kennedy Center for the Performing Arts and the United Nations headquarters. I am testifying today at the request of some committee members and the Tobacco Institute, which also is among our clients.

There is a virtual epidemic of indoor air pollution in buildings throughout this country, as revealed by ACVA's experience as well as studies by the National Institute for Occupational Safety and Health (NIOSH), the Environmental Protection Agency and others. By comparison, the examination of indoor air quality on airliners is in its early stages, but the evidence to date is alarming.

After reviewing all existing studies and data on air quality in aircraft cabins, along with trends in aircraft ventilation rates and design, one must conclude that poor air quality is a serious and growing problem on commercial airliners, representing a genuine threat to the comfort of passengers and a potential threat to their health. It is further evident that the only effort thus far to address the problem, the smoking ban, is not an effective solution to the problem. Rather, a solution must reduce the wider range of pollutants and other materials present in aircraft by addressing the root cause, inadequate ventilation, which may allow visible and invisible

contaminants to build up to unhealthy levels. And finally, it is clear that airlines and aircraft manufacturers are taking steps that are aggravating the problem of indoor air pollution rather than moving toward solving it.

"Sick Buildings"

While indoor air quality problems in stationary buildings are, in some details, different from the typical scenario on aircraft, the fundamental causes and types of pollutants are the same. Therefore, because the body of evidence regarding buildings is so substantial, some brief background in this area is instructive with regard to the issue at hand today.

Research demonstrates that the single leading cause of poor indoor air quality is inadequate ventilation. A NIOSH study found that 52 percent of indoor air quality problems were due to poor ventilation alone; ACVA studies show inadequate ventilation in 65 percent of the cases. Often, this is combined with poor air filtration.

As a result of inadequate ventilation and poor filtration, illness- or allergy-causing microbes, pollutants and other materials are allowed to build up in stagnant air to unacceptable levels. In 1987, we analyzed the first 227 buildings we had studied and the following pollutants were identified:

Carbon dioxide	64%
Fungi	34%
Bacteria	9%
Fiberglass	7%
Tobacco smoke	4%
Exhaust fumes	3%
Organic chemicals	2%
Other	5%

Symptoms of exposure to these pollutants, and others such as ozone and formaldehyde, are very similar to one another -- eye irritation, dry throat, headache, fatigue and various upper-respiratory difficulties. However, because tobacco smoke is the only visible pollutant, it is most often assumed to be the cause of such symptoms. As ACVA and NIOSH data show, tobacco smoke is the actual cause in only four percent of the cases; most often lingering smoke is a symptom of the larger problem, poor ventilation.

Airlines and the Economics of Ventilation

Just as in "sick buildings," the lack of adequate ventilation in aircraft reduces indoor air quality by permitting pollutants to accumulate. Some of these pollutants and some of their sources include carbon dioxide, produced by human breathing and dry ice in airplane galleys; atmospheric ozone; fibers and dust; nitrogen oxides; volatile organic compounds from fuel, cleaning fluids and other sources; nicotine from tobacco smoke; and bacteria, fungi and viruses from food and passengers.

The ventilation system that is intended to dilute these substances generally consists of outdoor air brought through the engines and either cooled by an air conditioner or, most often at cruising altitudes, cooled by outdoor air. Alternatively, the air can be partially recycled, mixing the outdoor air with "used" air from the cabin. While the plane is on the ground, external ground-based units may be used instead of running the engines. This practice, however, typically contaminates the air in a grounded aircraft with fumes from the ramp area.

Most aircraft today would be adequately ventilated if their systems were allowed to operate at capacity. But because reducing ventilation saves fuel, the systems are increasingly being cut back to use more recycled air and less fresh air. At first glance one can understand the motives for the airlines, since fuel prices have risen sharply since 1973.

In response to the fuel crisis, McDonnell Douglas issued a report in 1980 contending that reducing fresh air cabin intake in its DC-10s by 50 percent would save 0.8 percent on fuel, and that the airlines could save a maximum of 62,000 gallons of fuel per year per DC-10 by installing recycled air systems in those aircraft. The report was sent to 12 major airlines and two major aircraft manufacturers.

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However, a closer examination shows the savings from reduced ventilation to be shortsighted. For example, consider the following scenario aboard a 747 aircraft, which typically recycles air: Increasing ventilation from say, 10 cubic feet per minute (cfm) to a minimum recommended rate of 20 cfm per passenger on a five-hour flight aboard a full 747 would result in a total cost increase of $240, or approximately 60 cents per passenger.

It's my contention that airlines would improve cabin air quality and hence, passenger safety and comfort, by adopting a ventilation policy that operates at optimum levels. Then, by merely selling one additional ticket, the airline would easily recoup the costs of improving ventilation.

To illustrate the real inadequacy of ventilation rates employed by airlines, one simply must compare the current ventilation standard for buildings recommended by two leading engineering societies, the Association of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) and the Building Officials and Code Administrators (BOCA), with the rates found on board aircraft reported by the National Academy of Sciences. I will discuss the findings of this report in more detail.

Both ASHRAE and BOCA recommend a minimum amount of 20 cfm of fresh air per person. In stark contrast, the NAS report found that in a typical Boeing 747 flight, passengers in economy class

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received less than seven cubic feet of fresh air per minute -- only a third of the fresh air recommended by ASHRAE and BOCA. The rest of the air was recycled from the cabin.

Interestingly, the passengers in first class fare somewhat better with 30-50 cfm per person of fresh air, a much more comfortable and healthier atmosphere than their fellow passengers have in economy class. This is due to the greater density of passengers in economy class compared to first class. The cockpit, which requires a constant flow of clean, cool air to protect instrumentation, enjoys 150 cfm of fresh air.

It is unfortunate that, while the emergence of the "sick building" is leading building owners and operators to improve ventilation, the airlines are headed in precisely the opposite direction.

National Academy of Sciences Report

As you are aware, in 1986 Congress commissioned a literature review by the National Academy of Sciences' National Research Council on airline air quality and safety. The review was prompted by an escalation of complaints from passengers and flight attendants of symptoms typical of poor indoor air quality. The NAS/NRC findings regarding contaminants, in addition to data from other studies, are enlightening.

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NAS found carbon dioxide levels on aircraft in excess of limits recommended by ASHRAE and NIOSH; studies on Lufthansa showed levels more than twice the standard when operating air packs at 50 percent capacity.

Eleven percent of the flights in the NAS report violated FAA standards for ozone levels, with some levels more than eight times higher than recommended. This is a cause for concern especially when you consider that exposure to ozone, even at levels below the maximum limits, can cause eye, nose and throat irritation, as well as asthmatic symptoms.

Relative humidity also was studied as an environmental factor, with the general "comfort zone" considered to be between 30 and 65 percent. Low humidity can cause dry eyes, respiratory and skin irritation, and exacerbates irritation from other pollutants. NAS found relative humidities to be extremely low, from 2 percent to 23 percent.

In contrast to these findings,the NAS report and other studies have found no excessive levels of carbon monoxide, airborne particulates or nicotine, all of which have been linked to tobacco smoke as a source. Three studies of nicotine on aircraft showed levels, both in the smoking and non-smoking sections, to be well below ASHRAE and OSHA standards.

The NAS report did not include measurements of microbes. However, it is clear from other research that microbial

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contamination may be a significant factor on aircraft. The density of passengers aboard a tightly sealed airliner, combined with inadequate ventilation, makes an airplane almost ideal for the spread of fungi, bacteria and viruses.

In one case documented in the American Journal of Epidemiology, a passenger had a particular strain of influenza on a Boeing 737 that was grounded in Alaska for three hours; within three days of the flight, 72 percent of the other passengers came down with the same strain of flu. Another example, documented in Aviation, Space & Environmental Medicine (1976), is a Canadian study in which microbes were released in the rear of an empty Boeing 707, contaminating 100 percent of the aircraft cabin. It is not surprising that flu epidemics have been shown to spread along major air routes.

Smoking Bans

In light of its conclusions, NAS recommended a number of specific actions to improve cabin air quality. These included steps to enhance ventilation and air filtration, to set reasonable standards for pollutants, to encourage compliance and to establish an air quality monitoring program, as well as to ban smoking.

Ironically, of the NAS recommendations, the government and the airline industry have chosen to institute the only one that is

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not fully justified by scientific data and which has a more cosmetic effect on airline air quality, while ignoring the more far-reaching recommendations on ventilation. A ban on smoking addresses only one source of indoor air pollution, and not one that has been shown to exist at unacceptable levels aboard aircraft.

Tobacco smoke is the only pollutant that can be seen and smelled, making it a common suspect in passenger discomfort, an easy target for restrictions and scapegoat for the ubiquitous problem of poor indoor air quality. Some passengers simply do not like to be around tobacco smoke. As we have seen, a smoking ban also is a less expensive option for airlines that do not wish to improve ventilation, though on a per-passenger basis, the costs are minimal. However, the data demonstrate the importance of separating issues of comfort and economy from issues of science and health.

The Future of Airline Air Quality

Unfortunately, the trend toward restricted ventilation not only is continuing, but is beginning to be institutionalized in aircraft design and retrofit. Some new aircraft now are being built with ventilation systems designed to run on 50 percent recycled air. Some aircraft currently in service are being altered by the addition of more seating, although no changes are being made to the ventilation systems to accommodate additional passengers.

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As bottom-line measures to protect cabin air quality, I would recommend the following requirements to the committee:

- Maximize ventilation rates at all times.
- If design limitations require recycling of cabin air, enforce effective filtration, including: use of disposable prefilters followed by high-efficiency filters; use of charcoal or an equivalent filter for control of volatile organic chemicals, odors and ozone; and strict filter replacement schedules.
- Enforce compliance through routine inspection and air monitoring programs.

Conclusion

Mr. Chairman, the committee wishes to evaluate the smoking ban that was instituted on a temporary basis a year ago. According to all available data, a smoking ban has not and will not achieve clean indoor air in commercial airliners. In fact, the ban is being used to justify decreased ventilation, causing greater potential danger to passengers from less visible pollutants.

If the goal of the committee is to ensure a clean and healthy environment for airline passengers, improving ventilation standards and systems will go immeasurably further than attempts to react to any individual pollutant. And while ensuring adequate ventilation involves some minimal cost to airlines, this must be weighed against the substantial cost of polluted air to passenger comfort and safety.

Thank you.

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