

**DRAFT**

Statement of  
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Before The  
Subcommittee on Aviation  
of the  
Committee on Public Works and Transportation  
United States House of Representatives

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I am Larry C. Holcomb, an independent consultant in the field of environmental toxicology. I have been asked by The Tobacco Institute to present my views on the public health aspects of proposed legislation to prohibit smoking on commercial aircraft.

I hold a Ph.D. in Zoology from Michigan State University. From 1981 to 1986, I served as Executive Secretary of the Michigan Toxic Substance Control Commission. In that capacity, I supervised efforts to identify, monitor, and control the release of toxic substances in Michigan. My specialty as a consultant is identifying toxic exposures that pose a potential health problem, assessing the risks of such exposures, and devising action plans to manage risks at socially acceptable levels.

I am speaking today as a scientist offering my own evaluation of the health effects of exposure to environmental tobacco smoke (ETS) in commercial aircraft. I will not address issues that are relevant to your deliberations but outside the scope of my expertise, such as the role of passenger preferences in regulating smoking and fire safety issues posed by a smoking ban. My understanding is that other witnesses will address those issues.

In my professional judgment, a prohibition on smoking on commercial aircraft is not justified by current scientific evidence on the health effects of exposure to ETS. To explain the basis for this conclusion, I have divided my

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testimony into three parts. The first part briefly summarizes the unique characteristics of occupant exposure to environmental tobacco smoke in airplanes and explains why data on ETS gathered from other environments cannot reasonably be extrapolated to the airplane context. The second part addresses the principal scientific studies of ETS in aircraft. The third part of my testimony focuses on the 1986 report of the National Academy on Sciences (NAS) concerning cabin air quality and safety. The NAS report is frequently cited in support of a ban on smoking in airplanes. In part three of my testimony, I explain why NAS's data do not justify such action.

I.

Unique Aspects of Occupant  
Exposure To ETS In Airplanes

Three factors are of fundamental importance in assessing the merits of prohibiting smoking on airplanes from a health perspective. The first factor concerns the duration of occupants' exposure to ETS. Passengers typically are present in airplanes for very short periods of time, both on a per trip and annual aggregate basis. According to a Gallup survey conducted in 1985, over 80% of those who flew took three or fewer trips during the year. Since most flights last less than two hours, it appears that the great majority of passengers travel less than six hours a year by plane.

The exposure of flight attendants to ETS is also intermittent. A membership survey of the Association of

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Flight Attendants in 1985 found that 80% of those responding flew 70-85 hours per month. This is the equivalent of 2.3 to 2.8 hours per day. As I shall explain shortly, these periods of potential exposure to tobacco smoke on airplanes are far less than the chronic exposures typically evaluated in ETS studies.

Aircraft ventilation characteristics are the second factor of relevance to your deliberations. Commercial airliners are equipped with ventilation systems that provide fresh air at rates that have been found to compare favorably with the standards for non-aviation environments recommended by the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE).<sup>1/</sup> Based on an examination of seven transport aircraft in 1981, the Federal Aviation Administration (FAA) determined that ventilation systems in commercial aircraft provide 15.2 to 25.7 cubic feet of fresh air per passenger per minute, about three to five times the rate recommended for airplanes by ASHRAE.<sup>2/</sup> The ventilation rates on modern aircraft also exceed the proposed rate (15 cfm/person) for all transportation modes now under

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<sup>1/</sup> Cabin Air Quality: Hearing on S. 197 Before the Subcomm. on Aviation of the Senate Comm. on Commerce, Science, and Transportation, 98th Cong., 1st Sess 9 (1983) (statement of Craig Beard, Director, Office of Airworthiness, Federal Aviation Administration [hereinafter "FAA Statement"]).

<sup>2/</sup> U.S. Department of Transportation, Federal Aviation Administration, In the Matter of the Petition of Xenex Corporation, Denial of Petition, March 3, 1981.

consideration by ASHRAE.<sup>3/</sup> FAA has repeatedly stated that ventilation systems on commercial aircraft are "fully adequate," and as recently as 1983 found that there was "no need to require changes in aircraft ventilation systems" to deal with tobacco smoke "from a health perspective."<sup>4/</sup>

Current restrictions on smoking on airplanes are the third factor of relevance. Since 1973, airlines have been required to provide no-smoking sections in each class of service offered, and in 1985, the Civil Aeronautics Board (CAB) adopted a rule prohibiting smoking unless the aircraft's ventilation system is "fully functioning," i.e., "operating so as to provide the level and quality of ventilation specified and designed by the manufacturer for the number of persons currently in the passenger compartment."<sup>5/</sup>

These and other restrictions on smoking on aircraft, including a ban on cigar and pipe smoking, are now administered by the Department of Transportation (DOT). As I shall explain later in my testimony, the best available data indicate that existing regulations are effective in insulating non-smoking passengers from exposure to ETS.

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<sup>3/</sup> ASHRAE Standard 62-1981R, Ventilation for Acceptable Indoor Air Quality (Draft), August 6, 1987 at 15.

<sup>4/</sup> FAA Statement at 9-10.

<sup>5/</sup> 14 C.F.R. 252.3; see generally 14 C.F.R. 252.1-252.7.

Legislative proposals to prohibit smoking on aircraft have gained momentum recently due to reports on environmental tobacco smoke published in 1986 by the U.S. Surgeon General 6/ and the National Academy of Sciences (NAS) 7/. Both reports indicate that, with one exception, available data do not support conclusive findings as to the health effects in adults exposed to ETS. The one exception is lung cancer.

The findings on lung cancer draw heavily on studies of chronic exposure to ETS, in particular studies of non-smoking spouses in homes where the other spouse smokes. Even on their own terms, the reports of the Surgeon General and NAS are badly flawed and do not demonstrate a causal relationship between chronic exposure to ETS and an increased incidence of lung cancer. The epidemiological studies underlying the reports are beset by classification errors, reporting biases, and confounding variables that make the studies an inappropriate basis for regulation.

The studies do not adequately measure actual ETS exposure and are based largely on populations outside the

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6/ U.S. Surgeon General, The Health Consequences of Involuntary Smoking (1986).

7/ National Academy of Sciences, Environmental Tobacco Smoke: Measuring Exposures and Assessing Health Effects (1986).

United States, where differences in living conditions, genetic factors, health habits, diet, risk-taking, occupational exposure, levels and quality of indoor air pollution, and other factors make extrapolation to the United States population problematic at best. More importantly, when NAS combined the epidemiologic studies of United States populations, it found no increased risk of lung cancer.

Surveying the same epidemiologic evidence considered by NAS and the Surgeon General, the International Agency for Research on Cancer of the World Health Organization concluded, also in late 1986, that the available evidence is consistent with a finding of no increase in risk -- either in the United States or elsewhere.<sup>8/</sup> A number of other studies simply fail to establish a statistically significant association between lung cancer and ETS exposure.

Even if the findings concerning health effects of chronic exposure to ETS were valid, they cannot reasonably be extrapolated to the airplane context, in view of the factors I have mentioned. Federal officials seeking to ensure the safety of airline service have explicitly determined that restrictions on smoking are not justified by studies of chronic exposure to ETS.

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<sup>8/</sup> World Health Organization, International Agency for Research on Cancer, IARC Monograph on the Evaluation of the Carcinogenic Risk of Chemicals to Humans: Tobacco Smoking, vol. 38, p. 308 (1986).

In 1985, for example, the CAB declined to cite health considerations as a basis for adopting further restrictions on smoking on aircraft. After a thorough and careful analysis of extensive record evidence, the CAB found that data on the health effects of ETS were "still being disputed" and were not applicable to exposures on aircraft because:

The cited studies involved smoking in the home or office, places where people spend a significant portion of their life. This differs from the situation aboard aircraft where most people spend a relatively short time. Aircraft also differ from homes and offices in that nonsmokers are separated from the smokers in the former,<sup>9/</sup> but usually are not in the latter.<sup>10/</sup>

Similarly, in 1983, FAA expressed the view that, based on long-term ETS exposure studies:

[C]ausal exposure to second-hand cigarette smoke in a reasonably ventilated environment is not expected to have any relationship to cardiovascular or pulmonary disease causation.<sup>10/</sup>

I am not aware of any scientific basis for setting aside these findings of the CAB and FAA.

## II.

### Studies of ETS in Commercial Aircraft

In evaluating the scientific merits of a ban on smoking on airplanes from a health perspective, it is

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<sup>9/</sup> 49 Fed. Reg. 25410 (1984).

<sup>10/</sup> FAA Statement at 10.



imperative that the greatest weight be given to studies that directly examine the effects of ETS exposure in airplanes. Four such studies have been conducted in the last sixteen years. All of them indicate that exposure to ETS does not pose an appreciable health risk to non-smoking passengers.

In 1971, FAA and the National Institute for Occupational Safety and Health (NIOSH) completed a joint study entitled "Health Aspects of Smoking in Transport Aircraft."<sup>11/</sup> The purpose of the study was to define the levels of certain combustion by-products of tobacco produced by passengers' smoking and to evaluate the health effects of exposure to such by-products. The study was conducted prior to the adoption of federal regulations requiring airlines to provide no-smoking sections.

The study encompassed 20 Military Airlift Command (MAC) flights between the United States and destinations in Asia and Europe, and 14 domestic flights. The MAC flights ranged in length from 7 to 11 hours; the domestic flights from about 1 to 2 hours. Researchers collected samples to determine environmental levels of carbon monoxide, particulate matter, polynuclear hydrocarbons, ammonia, and ozone during the flights.

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<sup>11/</sup> Department of Transportation and Department of Health, Education and Welfare, Report on Health Aspects of Smoking on Aircraft (December 1971).

The researchers reported that "the results of environmental sampling revealed very low levels of each contaminant measured, much lower than those recommended in occupational and environmental air quality standards." The researchers concluded that "these combustion products were judged not to represent a hazard to the nonsmoking passengers, based on environmental levels and expected dosage-response relationships of contaminants."<sup>12/</sup>

In 1983, researchers at the San Francisco General Hospital Medical Center reported the results of a study of nicotine absorption by non-smoking flight attendants during a round trip flight between San Francisco and Tokyo. Six stewardesses participated in the study. All were full-time flight attendants who worked 68 to 73 hours per month. Five of the stewardesses were assigned to the smoking section of the Tokyo-San Francisco return leg of the flight.

Blood samples were taken before departure and within one hour of return to San Francisco. Urine samples were also taken. The researchers found that passive absorption of nicotine during this lengthy trip was "relatively small" and that "the concentrations achieved are unlikely to have any physiologic effects."<sup>13/</sup>

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<sup>12/</sup> Id., at iii-iv.

<sup>13/</sup> Foliart, et al., Passive Absorption of Nicotine in  
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In 1984, a group of Japanese researchers published the results of a sampling survey of nicotine measurements in the ambient air of various indoor environments, including offices, conference rooms, cafeterias and commercial aircraft.<sup>14/</sup> The purpose of the study was to evaluate the actual levels of exposure of non-smokers to tobacco smoke in such settings. The Japanese researchers used a monitoring device consisting of a sampler tube and portable pump equipped with a mechanical counter to measure volume.

The researchers reported that nicotine measurements on seven domestic aircraft ranged from 6.28 to 28.78 ug/m<sup>3</sup>, the equivalent on average of about 8 one-thousandths of a cigarette per hour. The levels of ambient nicotine in aircraft ranked ninth lowest among the thirteen settings in which measurements were taken.

In 1986, Guy B. Oldaker, a senior research chemist at R.J. Reynolds Tobacco Company, and a colleague, conducted an ETS sampling survey on 66 domestic airline flights ranging in length from 13 to 179 minutes.<sup>15/</sup> Oldaker measured the

(Footnote Continued)

Airline Flight Attendants, 308(18) N. Eng. J. Med. 1105 (1983).

14/ Muramatsu, et al., Estimation of Personal Exposure to Tobacco Smoke With a Newly Developed Nicotine Personal Monitor, 35 Environmental Research 218 (1984).

15/ Oldaker and Conrad, Estimation of the Effects of Environmental Tobacco Smoke (ETS) on the Air Quality Within  
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presence of nicotine in the ambient air using a constant flow sampling pump fitted with a small collection tube. Oldaker's sampling technique was a sophisticated version of a method developed by NIOSH.

Oldaker found that separation of smokers and non-smokers effectively insulated non-smoking passengers from exposure to ETS. He determined that concentrations of ETS in smoking sections were small, ranging from 0 to 3 one hundredths of a "cigarette equivalent" per flight, with an average of four one-thousandths of a cigarette equivalent. Oldaker reported further that concentrations of ETS dropped precipitously in proportion to the distance from the smoking section, and that exposures to ETS in the no-smoking section were infinitesimal, ranging from 0 to 1 one-hundredth of a cigarette equivalent, with an average of 3 one-thousandths of a cigarette equivalent.

Based on these measurements, Oldaker estimated that it would take eight continuous 28-hour round trip flights from New York to Tokyo for a passenger seated in a typical no-smoking seat on a United States airliner to be exposed to the nicotine equivalent of one cigarette. This amounts to 224 hours -- over one fourth the average flight attendant's annual in-flight time -- or more than nine days in the air. I know

(Footnote Continued)  
Aircraft Cabins, accepted for publication, Environmental Science and Technology (October, 1987).

of no scientific data indicating that the de minimis exposures reported by Oldaker or the Japanese researchers pose a significant health risk.

III.

NAS Study of the Airliner Cabin Environment

In 1986, a committee of the National Research Council of the National Academy of Sciences issued a report on air quality and safety aboard commercial aircraft.<sup>16/</sup> The report urged that smoking on airplanes be banned to "reduce potential health hazards to cabin crew" and to "bring the cabin air quality into line with established standards for other closed environments." The report also urged that a ban was justified in order to lessen "irritation and discomfort" of some passengers and crew.<sup>17/</sup> In my opinion, there is a serious disparity between the report's recommendation on smoking and the equivocal and inconclusive evidence offered in support of that recommendation.

The NAS committee found that "aircraft air quality has not been a subject of systematic investigation by independent researchers" and that "no published peer-reviewed data on ETS concentrations in cabins were available."<sup>18/</sup> Without

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<sup>16/</sup> National Research Council, The Airliner Cabin Environment: Air Quality and Safety (1986).

<sup>17/</sup> Id. at 6-7.

<sup>18/</sup> Id., at 6, 137.

reliable exposure estimates, it is impossible to conduct a valid risk assessment. The committee itself explicitly recognized that "[m]uch more research must be conducted before risks can be accurately assessed."<sup>19/</sup>

The committee nonetheless speculated that flight attendants assigned to smoking sections could be exposed to ETS in amounts equivalent to those supposedly involved in living with a one-pack-a-day smoker. The committee left the impression that exposure at these levels "could" pose a "potential" health problem. The committee was aware of the FAA, Oldaker and San Francisco Medical Center data suggesting otherwise, but essentially ignored them. The committee evidently was unaware of the Japanese findings.

The Committee's estimate of exposure levels apparently was based on a few isolated measurements of respirable particles (RSP) taken by airline personnel or committee members. The committee conceded that "the measurements have not been conducted under experimental situations or have not been conducted systematically for a variety of aircraft."<sup>20/</sup> Exposure levels can be highly variable, and random measurements may therefore greatly distort analysis. The sampling methodologies relied upon by

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<sup>19/</sup> Id., at vii.

<sup>20/</sup> Id., at 137.

the committee have not been adequately disclosed, and there is no basis for assessing their reliability.

The ETS concentrations hypothesized by the committee are far greater than those indicated by the nicotine measurements recorded by Oldaker on a large sample of flights, and by similar measurements taken by the Japanese. Moreover, nicotine is specific to tobacco smoke; RSP, which has many sources, is not. For example, RSP concentrations may be elevated merely by physical activity in the area of measurement. By relying on RSP as a surrogate for ETS, the committee may have further distorted its assessment.

The NAS report states that "health effects from other environments do not permit us to present reliable quantitative risk estimates related to the health impact of present concentrations of ETS on exposed non-smokers in an aircraft environment."<sup>21/</sup> The committee nonetheless relies exclusively on data collected in other environments as a basis for suggesting adverse health effect of ETS in airplane passengers. The committee focuses in particular on the purported effects of ETS exposure on pulmonary disease, but makes no mention of inconsistent findings or flaws in study design, such as those I previously identified. The committee greatly overstates the strength of the epidemiological evidence in this area.

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<sup>21/</sup> Id. at 150-151.

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The NAS analysis of health effects of ETS on airline passengers is scientifically inadequate in many other respects. The committee asserts that passenger smoking patterns cause highly transient concentrations of ETS in the no-smoking sections of the cabin, but offers no citations or data to support this assertion. The report also implies that ETS is routinely recirculated in the cabin, but data presented elsewhere in the report indicate that recirculation of cabin air may be far less common.

The report simply ignores FAA's findings with respect to the adequacy of ventilation on commercial aircraft, and makes no effort to evaluate any of the four principal studies of ETS in aircraft. The omission from NAS's analysis of any serious discussion of these reports is indefensible.

The committee indicated that a ban on smoking is justified in order to bring cabin air quality "into line" with established standards for other closed environments. The scientific basis for this assertion is unclear. The committee suggested that RSP levels caused by smoking in planes would exceed a federal RSP standard, if one existed. Such speculation obviously is not a substitute for scientific analysis. The committee recognized that there is inadequate data to assess the impact of ETS on levels of specific cabin air contaminants and, therefore, no basis for comparing them to existing standards.

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NAS also recommended a ban on smoking in order to lessen the "irritation" and "discomfort" of some passengers and crew. So far as I am aware, there is no scientific data on the extent to which ETS is a cause of irritation and discomfort to occupants of aircraft. Although ETS may be troublesome to some individuals, several other aspects of the cabin environment, including low relative humidity, carbon dioxide, ozone and volatile organic compounds may also be the cause of discomfort. To my knowledge, the NAS committee made no effort to disaggregate these variables, or to articulate a principled basis for establishing certain passenger preferences as the norm governing all occupants' behavior during commercial flights.

I understand that the Department of Transportation has declined to implement the committee's recommendation to prohibit smoking on aircraft, and has stated that "further study is needed before the Department can propose a definitive response to this recommendation."<sup>22/</sup> The Department has specifically found that further analysis is needed of ETS in aircraft and that discussions will be renewed with the Environmental Protection Agency (EPA) regarding the feasibility of a program to measure cabin air quality aboard commercial aircraft. In my opinion, the Department's position

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<sup>22/</sup> U.S. Department of Transportation, Report to Congress on Cabin Air Quality (February, 1987) at i.

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is a measured and scientifically sound response to the NAS report.

Conclusion

The great weight of evidence now available does not support the conclusion that exposure to ETS causes adverse health effects in non-smoking passengers or crew. The proposed legislation to prohibit smoking on aircraft accordingly is not justified on public health grounds.

Public policy on smoking on aircraft should be based on the best possible scientific evidence. Further research along the lines proposed by the Department of Transportation is therefore desirable.

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