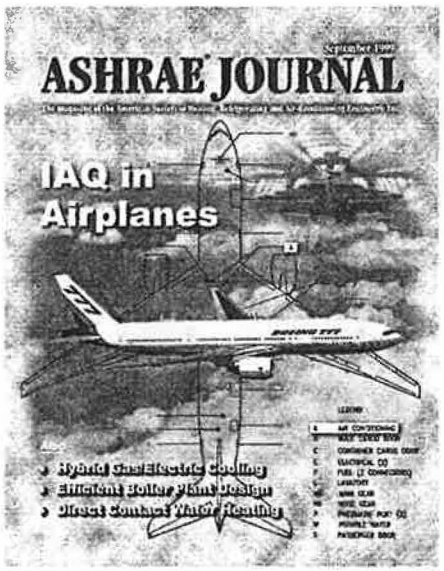
A Look at the Issues and Debate

IAQ on Passenger Planes

By Jolanda N. Janczewski, Ph.D.

In 1998, U.S. airlines had more than 7.7 million aircraft departures, flew approximately 600 billion revenue passenger miles and enplaned nearly 500 million passengers, with an average trip length of more than 1,000 miles.

The controversy surrounding airliner cabin air quality has been debated for some time. The perception that the air quality within commercial aircraft is the cause of, or can be associated with symptoms experienced by passengers and crew has been the subject of scientific, public and even congressional debate. However, despite numerous studies, meetings, seminars, hearings and press coverage, no definitive association between in-flight cabin air quality and symptoms has been identified.



In the wake of the second U.S. Congressional Hearings on the subject in 1993, ASHRAE formed the Aviation Subcommittee to Technical Committee (TC) 9.3, Transportation Air Conditioning, to examine the issue of airliner air quality. The committee is comprised of representatives from the various interested parties including the aircraft manufacturers, airlines, flight attendants, component (filtration, etc.) manufacturers and consultants. Committee members have diverse backgrounds including public health experts, medical doctors, industrial hygienists, engineers, toxicologists and environmental health specialists. The committee, *inter alia*, established a research committee and a standards committee (SPC 161) to determine whether a separate standard was needed for this unique environment (the results of the first research project sponsored by the TC 9.3 research committee is presented in this issue on Page 26).

Not since Standard 62R has there been so much hot debate and emotions expressed at an ASHRAE committee meeting. There are almost as many different opinions and agendas as there are members on the committees. The emotion at the meetings primarily stems from the flight attendants, supported by union representatives and consultants. This group asserts that their workforce suffers from both long- and short-term health effects that are caused by pollutants or conditions within their working environments. They provide the committees with anecdotal stories about crewmembers (and sometimes passengers) experiencing headache, hypoxia, neurological disorders and other symptoms while onboard aircraft. To date, however, no scientific studies or data substantiating these assertions have been provided for the committees' review.

In another corner of the committee meeting tables sits the aircraft manufacturers, primarily represented by environmental control system (ECS) design engineers and their consultants. In response to the flight attendant assertions, this group has re-examined their systems and conducted their own internal scientific evaluations, with some data presented for committee review and comment. To date, none of these data have identified causal factors for the reported symptoms. In general, however, this group believes that the design of the systems is adequate to meet the needs of the occupants and that problems may be arising from the ground operations or improper maintenance practices.

Also at the table are the various airlines, both international and domestic. Many in this group have also conducted their own examinations and have provided the committees with some data for evaluation. To date, data have been consistent with other studies and fails to identify a causative factor for symptoms. The airlines continue to look to the manufacturers for assistance in ECS design improvements.

The committee also is comprised of various experts in environmental testing and evaluation, as well as a host of engineers. Reports and presentations provided by these committee members have shown aircraft cabin contaminant levels well below those likely to cause significant health effects. In addition, these experts continue to assert that there is a lack of evidence to support the theories being expressed. Using the most state-of-the-art sampling strategies, and conducting continuous review of the data provided by committee members and outside studies, the data has failed to establish a recognized risk.

The center of the discussions held during the various meetings has been a moving target, with opinions evolving almost as fast as the committee members (and sometimes the public media) can generate them. Initially, problems were blamed on exposure to environmental tobacco smoke, and it seemed that

the banning of smoking aboard commercial airlines would alleviate the concerns. However, the complaints from flight attendants have not only continued since the ban, but some airlines have actually reported an increase in complaints since that time. In addition, a comprehensive study by the DOT/FAA showed little to no migration of ETS from smoking to nonsmoking aircraft sections, and in some cases showed higher levels of ETS indicators on nonsmoking flights than in the nonsmoking sections of smoking flights.

Initially, problems were blamed on exposure to environmental tobacco smoke, and it seemed that the banning of smoking aboard commerical airlines would alleviate the concerns. However, the complaints from flight attendants have not only continued since the ban, but some airlines have actually reported an increase in complaints since that time.

At one point the discussions focused on increased levels of CO_2, whichare commonly experienced in the aircraft environment. Typically, levels around 1,500 ppm are found. Although these levels are higher than the 1,000 ppm recommended by ASHRAE Standard 62-1989, *Ventilation for Acceptable Indoor Air Quality*, for odor perception in commercial buildings, the levels are far below the health threshold established by the FAA and OSHA (5,000 ppm). While recognizing that these higher levels of CO_2 do not present a health hazard, they have lead to the theory that more recent ECS designs, using a percentage of recirculated air, are causing increased contaminant levels and thus, increased symptoms. However, as generated data have begun to show limited contaminants in aircraft with recirculated systems, and HEPA filtration is becoming the standard in the industry, this issue is coming to rest. Thus, the SPC 161 committee has accepted the need to establish a higher recommended CO_2 level for aircraft cabins.

At one time, elevated ozone levels were suspect. However, further research established that aircraft ozone converters were effective in removing high levels, although the issue may still be relevant to flights in northern latitudes. The possibility of disease transmission, primarily tuberculosis, has been postulated quite often in the popular press. But, a close examination of all suspected cases of TB transmission onboard commercial aircraft has clearly dispelled such theories and shown that any risk is associated with close contact with infective persons and not the aircraft ventilation system. Similarly, other reports of disease transmission have been associated only with on-ground conditions when the ECS is not operable.

Recently, a new theory is being examined: exposure to hydraulic fluid leaking from the aircraft engine bleed air into the cabin. In response, the TC 9.3 Research Committee has commissioned the second of its projects to examine engine bleed air. The project is on hold as the researchers need to find an airline with which to work. In addition, the study has been criticized for not looking at the extremes of potential effluents resulting from known sources (i.e., an incident involving a leak in a hydraulic line).

In addition to specific contaminants, the committee has discussed other factors which could contribute to aircraft cabin occupant symptoms. These have included the nature of flight attendant duties, altitude/pressure changes, circadian rhythm upset, exposures in other environments (i.e., hotel rooms), and outside work activities. While much discussion has been afforded to such theories, little study has been accomplished in

FORUM

these areas, and thus, more investigation is needed.

It is becoming evident that much of the concern and noted problems are not actually associated with in-flight conditions, but rather during ground periods when the ECS is not used. While the aircraft is on the ground, occupants are moving around the cabin, the aircraft is refueled, outside pollutants are brought into the cabin, and outside temperatures and humidity influence the condition of the cabin air. More emphasis should be placed on when symptoms are actually experienced so that efforts are not unnecessarily expended towards in-flight investigations, especially if data show problems primarily during on-ground periods. Although much criticism has been levied against the FAA for not reacting to the alleged problems, this agency only regulates ventilation effects in flight, and a lack of data supporting substantial in-flight problems leaves them with their hands tied.

At present, the TC 9.3 Aviation Subcommittee continues to hold its meetings, listen to the concerns of the interested parties and explore other possible causation factors. Similarly, the SPC 161 Committee, headed by Larry Holcomb, Ph.D., continues to work on a draft standard for acceptable cabin air quality on commercial aircraft. The standard will address acceptable ventilation rates, and include levels for relative humidity, performance requirements for filtration, temperature, pressure and maximum allowable levels of ozone and other contaminants.

While it may appear from the outside that little to no progress has been made over the past five years, the long process of theory elimination has better focused the committees' attention and identified areas for further investigation. Much credit should be given to the many hardworking members of the committees. This has been a rare opportunity for so many adversarial parties to work together for a common cause. Although emotions flare and opinions abound, there have been moments of understanding and even compromise. This process should yield a standard that will benefit not only the traveling public and aircraft crew, but also provide guidance to manufacturers designing ECS and airlines operating commercial aircraft.

References

1. Air Transport Association. July 1999. "ATA data and statistics." web site: www.air-transport.org/data.

About the Author

Jolanda N. Janczewski, Ph.D., is president of Consolidated Safety Services and a member of the Aviation Subcommittee for ASHRAE Technical Committee 9.3, Transportation Air Conditioning. She has been the principal researcher for ASHRAE 957 Research Project, Relate Air Quality and Other Factors to Symptoms Reported by Passengers and Crew on Commercial Transport Category Aircraft, along with other studies on airliner air quality. ■