

ENVIRONMENTAL ISSUES IN THE AIRCRAFT PASSENGER CABIN

Mary Edwards and Elwyn Edwards
Human Technology, Stratford-upon-Avon, United Kingdom

INTRODUCTION

The aircraft passenger cabin presents a variety of environmental problems. Flight is conducted through an extremely hostile external environment. The temperature is very low; the atmosphere is rarefied; there may be high levels of radiation and of ozone. Severe levels of turbulence may be encountered. All forms of protection and defence must be carried aboard with their attendant cost penalties. Relative humidity, for example, may fall significantly during a long flight, and the amount of water necessary to maintain a comfortable level might well require the removal of 10 or 20 passengers from the maximum payload. Similarly, substantial savings in fuel costs can be achieved by a reduction in the ventilation rate, and an increase in the proportion of air recirculated. In the face of technical problems and economic pressures, it is of the utmost importance to establish and enforce minimum standards for the protection of personnel in the cabin.

NORMAL OPERATION

Flight attendants are more vulnerable than passengers to the environmental stressors in the cabin because of their increased long-term exposure and because of the high levels of activity during flight. Passengers at the extreme of the age range are more vulnerable than those in the middle range because of their reduced ability to respond quickly to environmental change. The stressors encountered in the cabin in normal flight include low levels of air quality, reduced air pressure, turbulence, and the disturbance of circadian rhythms.

The concentration of ozone in the air increases with altitude. The Federal Aviation Administration has established a limit of ozone concentration in the passenger cabin of 0.1ppmv (parts per million by volume) and peaks at 0.25ppmv. Levels in excess of 0.25ppmv have been reported in some aircraft. The effects of ozone are experienced in the respiratory system viz coughing, irritation in the throat, chest discomfort and difficulty in breathing.

Cosmic radiation levels also increase as altitude increases and pose a problem for flight attendants flying at high altitudes, particularly if they are females in the early stages of pregnancy. Relatively small doses of radiation may have deleterious effects on the foetus, causing leukaemia, deformity, or stillbirth.

The reduction of air pressure to the equivalent of about 6000ft can be problematic for some passengers. Those who are elderly may suffer from slight hypoxia leading to mental confusion and inappropriate behaviour. Chronic states which may become acute under the conditions of cabin pressure include asthma, epilepsy, and cardiac problems. Discomfort and pain may be experienced by those with middle ear infections, respiratory infections and gastro-intestinal problems. Flight attendants may suffer from bloated stomach and swollen legs.

On the ground, comfortable levels of relative humidity are around 40-60% depending upon the season of the year. In one study, the level of relative humidity in a Boeing 747 was found to fall to 8.5% during flight.

Regulations promulgated by the Federal Aviation Administration govern certain features of air quality in the cabin. Maximum permissible levels of ozone and carbon dioxide are subject to regulation; radiation and humidity levels are not. The introduction of regulations is a lengthy process, often beginning as a response to the pleas of special interest groups. All aspects and implications must be considered.

In recent years, public opinion has played a major role in the introduction of a ban on smoking in the aircraft cabin which operates in a number of countries. This has been achieved in spite of the lack of convincing evidence that Environmental Tobacco Smoke (ETS) is more of a threat to health than some

of the other pollutants which have not attracted popular attention. Indeed, it **has** been argued' that the removal of ETS may lead to reduced **air** quality because, in the absence of a readily detected pollutant, there is no marker to indicate the quality of the **air**.

EMERGENCIES

The general precautions taken to prepare for emergencies are well-known. Oxygen masks are fitted which deploy **automatically** in the event of a sudden decompression. Seatbelts are provided to afford **stability** in the presence of turbulence in addition to their function in the vicinity of the ground. Inflatable slides provide a means of escape **on** the ground and these will normally deploy **as soon as** a cabin door is opened. Life rafts, vests, and **flotation** cushions are available for use in the event of **ditching**. Fire extinguishers of various types are carried to deal with **in-flight fires**, and current discussions address the question of whether smokehoods should be made available for passengers.

Experience has show that the hardware solutions, **as** outlined above, are **insufficient** to provide the maximum protection for passengers. A more comprehensive view of the issues, as provided by the SHEL model³, draws attention to the importance of the procedural aspects of safety and the relevance of proper training of both crew and passengers. Passengers have frequently failed to make use of the equipment available to them, whether a lifejacket or an oxygen mask. They have taken inappropriate steps to avoid smoke and fire, and have been unable to operate safety equipment. Whilst the necessary hardware is essential in order to facilitate **survival** in an emergency, the establishment and **rehearsal** of procedures **is** a **no** less essential facet of environmental ergonomics in the **aircraft** passenger cabin.

REFERENCES

1. National Research Council Committee on Airliner Cabin Air Quality 1986, *The Airliner Cabin Environment* (National Academy Press, Washington D.C.).
2. Robertson, G. 1991, Indoor air quality in public transportation, Paper presented to the Ninth World Congress of the International Flight Attendants Association, Dublin.
3. Edwards, M. and Edwards, E. 1990, *The Aircraft Cabin: Managing the Human Factors* (Gower Technical Press, Aldershot).