ALPA WHITE PAPER

ENHANCING PILOTS' OCCUPATIONAL HEALTH AND SAFETY PROTECTIONS

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FOREWORD FROM ALPA PRESIDENT CAPT. JOE DEPETE

Airline pilots are used to sacrifice . . . But pilots should not be expected to endanger their health and safety as a condition of employment.

A fundamental need of every pilot is a workplace which is free from undue hazards. While the airline industry has made magnificent strides in improving operational safety, more needs to be done to protect flight crews from insidious threats on the flight deck. Dangers like cabin air quality events, unsanitary conditions onboard aircraft, unhealthy potable water, and other occupational safety and health detriments all pose risks that are deserving of greater attention and resources than they have received to date.

Airline pilots are used to sacrifice—long hours studying technical manuals and learning systems, time away from family and friends for work or training, and an ever-changing work environment. But pilots should not be expected to endanger their health and safety as a condition of employment. The risks identified in this paper can adversely impact the long-term fitness of flight crews, and passengers, with even minimal exposure.

I truly believe in the dignity of labor and work. For over 90 years, ALPA has worked to improve the safety and security of our passengers and cargo from the dangers in the sky we can see. ALPA pilots are also working with government regulators and industry to improve and remedy shortcomings identified herein for the benefit of the flying public and crewmembers—present and future.

This paper, which was developed by our outstanding Pilot Assistance Group, with support from our Engineering & Air Safety Department, explains the nature of the occupational safety and health threats which pilots encounter every day. It explains the roles and responsibilities of the regulators and the airlines for ensuring that those threats are properly identified and mitigated and urges action for needed improvements. It is a must-read for anyone who is interested in knowing more about this aspect of the line pilot's work environment.

Joseph G DePete

Capt. Joe DePete
ALPA President

EXECUTIVE SUMMARY

The airline flight deck is one of the most coveted workplaces, as can be attested to by the more than 100,000 pilots in the United States and Canada who work hard and sacrifice to earn a seat at the controls of a transport category airline aircraft. However, despite the attractiveness of an airline pilot career, the flight deck environment is very industrial in nature and can be the source of serious injuries and long-term health issues. As such, it needs protections for pilots that are commonly found in other industries. This white paper explores the various types of health and safety risks found on the flight deck and in the aircraft cabin and provides recommendations on ways to address identified inadequacies across a wide range of topics and health threats. These inadequacies need to be addressed by federal agencies charged with establishment and enforcement of rules and policies designed to protect airline pilots while carrying out their duties at work.

In the United States, the Federal Aviation Administration (FAA) is the primary regulatory authority concerning aviation occupational health and safety, although other federal agencies are also involved in certain narrowly defined aspects. Similarly, Transport Canada (TC) is the primary regulatory authority in Canada in this regard. There are stark differences, however, between the two agencies' approaches to their oversight and engagement on it. In the United States, pilots are not protected by the safety and health standards which the Occupational Safety and Health Administration (OSHA) employs to safeguard employees in other industries. The FAA has maintained statutory authority in this area, but its regulations, guidance, and oversight are significantly less robust and comprehensive than those of OSHA. In Canada, the Aviation Occupational Health and Safety program combines provisions of the Canada Labour Code with Transport Canada's Aviation Occupational Health and Safety Regulations to address the health and safety of crewmembers. ALPA believes that there is need for improvement by the FAA in this regard.

In order to fully carry out their mission, we recognize that both the FAA and TC likely require additional resources to protect the health and safety of the most important safety feature on any airline aircraft: at least two well-trained, fully qualified, highly experienced, and adequately rested professional flightcrew members.

INTRODUCTION

This white paper is a third edition of one published in 2015 and 2020 by the Air Line Pilots Association, Int'l (ALPA, *www.alpa.org/whitepapers*). It provides new and updated information on numerous issues that were not addressed in prior versions and is intended to be responsive to direction from the 2018 ALPA Board of Directors, which tasked the Pilot Assistance group to:

- "Ensure proper oversight of aviation occupational health by the U.S. and Canadian governments" and
- "Provide resources and advocate for the highest levels of safety and oversight of all ALPA pilots' onboard environmental working conditions [e.g., potable water, air quality, radiation, cleanliness]."

BACKGROUND AND GENERAL INFORMATION

There is no more important attribute of the airline pilot's career longevity and earnings than their health. Aviation regulations require pilots to obtain and maintain a medical certificate to fly for the airlines, so any health issue which may threaten a pilot's career is taken very seriously.

ALPA's Air Safety Organization (ASO) Pilot Assistance (PA) Group was created for and is devoted to helping pilots achieve and sustain good physical and mental health. It enhances pilots' professional performance and, when necessary, provides rehabilitation through drug and alcohol intervention. The PA Group coordinates and conducts research to address physical and emotional issues that may affect a pilot's ability to perform their work. These activities are carried out by the group's six disciplines: Aeromedical, Human Intervention and Motivation Study, Critical Incident Response Program, Canadian Pilot Assistance, Professional Standards, and Pilot Peer Support. The PA Group is an active participant on and helps lead numerous International Federation of Air Line Pilots' Associations (IFALPA) committees, government and industry organizations, and other professional associations. It also works closely with ALPA's Aeromedical Office and the ALPA aeromedical advisor.

The issue of occupational safety and health has always been important, but it has grown significantly more so to ALPA's membership in recent years due to ongoing and numerous reports of significant cabin smoke and fume events, unsanitary conditions onboard aircraft, unhealthy potable water, and other occupational safety and health detriments. The ALPA Air Safety Organization, through the efforts of the Pilot Assistance and Safety Groups, began a collaborative effort to address these problems in 2019 with the creation of a new Health and Environment Working Group (HEWG). The HEWG, which is led by the chairs of both groups, originated as a recommendation at an ALPA cabin air quality (CAQ) meeting in February 2019. It held its first meeting in September 2019 to review its mission and develop an initial strategy for assessing CAQ events, building awareness of these occurrences, and identifying best practices and workable solutions. HEWG's first focus is CAQ, but in the future it will delve into the other occupational health and safety issues identified herein.

THE REGULATORY ENVIRONMENT IN THE UNITED STATES

The Occupational Safety and Health Act (OSH Act) of 1970 was promulgated to ensure a safe and healthful working environment for all workers in the United States. The OSH Act created the Occupational Safety and Health Administration (OSHA) with authority to develop and enforce workplace health standards. The OSH Act also established the National Institute for Occupational Safety and Health (NIOSH) as part of the Centers for Disease Control and Prevention.

When Congress enacted the legislation creating OSHA, it limited the administration's authority to prescribe or enforce standards or regulations affecting occupational safety or health when another federal agency opts to exercise such statutory authority. In this regard, the FAA asserted jurisdiction with respect to the working conditions of aviation employees on aircraft in operation. It is ALPA's view that the FAA must be the sole regulator of the flight deck environment because of the strong interconnection between occupational health and safety with aircraft certification and operation standards. Unfortunately, ALPA believes that the FAA has not been as active as it should be in this regard due to inadequate funding and available staffing resources.

In 1975, the FAA published guidance information that detailed the agency's role with respect to occupational health conditions affecting aircraft crewmembers on aircraft in operation. In 2000, and again in 2014, the FAA and OSHA

signed memorandums of understanding which were intended to facilitate coordination and cooperation between the two agencies regarding the application of certain OSHA standards for aircraft cabin crewmembers. The 2014 MOU[1] stipulates that OSHA will enforce its regulations pertaining to aircraft cabin crewmembers in three specific areas: hazard communication, bloodborne pathogens exposure, and occupational noise. The document also references three other OSHA requirements that the agency applies to cabin crewmembers that precede the MOU: recordkeeping, access to employee exposure and medical records, and the antidiscrimination (i.e., whistleblower) provision of the 1970 OSH Act. The FAA has retained authority to regulate all other aspects of cabin occupational safety and health, and all occupational safety and health aspects for the flight deck crew. Although the FAA has staked out this authority, it is not using it to the maximum practical extent to adequately establish appropriate minimum standards for occupational safety and health.

The FAA's Civil Aerospace Medical Institute (CAMI) in Oklahoma City, Okla., serves as the medical certification, research, education, and occupational health branch of FAA Aerospace Medicine. The primary focus of CAMI is the health and well-being of aviation passengers, crewmembers, and air traffic controllers. CAMI studies and has published numerous reports on human performance in the aerospace environment.[2]

Despite the numerous CAMI brochures and documents, the FAA has very few specific regulations concerning occupational health and safety.[3] Nor does the FAA have a comprehensive advisory document on occupational health and safety to provide guidance and resources to airlines and employees on best practices for the multitude of health and safety topics in this area of oversight. The FAA does not conduct inspections of airline occupational health and safety programs; it also does not have dedicated staff for reviewing and conducting oversight of airline occupational health and safety programs.

As described within this white paper, although other U.S. federal agencies are involved in certain narrowly defined aspects of interest, the FAA is the primary regulatory authority concerning aviation occupational health and safety.

THE REGULATORY ENVIRONMENT IN CANADA

The Canada Labour Code (the Code) applies to employees who work under federal jurisdiction, which encompasses about 10 percent of the Canadian workforce. TC is responsible for on-board employees in the aviation, marine, and rail sectors under federal jurisdiction. The headquarters division provides guidance and assistance to Regional Civil Aviation Safety Inspectors-Occupational Health and Safety, who conduct inspections, investigations, and promotional visits to ensure that air operators are committed to the health and safety of their employees.

TC has a mature and well-defined occupational health and safety program. The following description of TC's program is provided on its website:[4]

> The Aviation Occupational Health & Safety [AOHS] Program's main objective is to ensure the health and safety of crewmembers on board aircraft. This is accomplished through the administration, enforcement and promotion of Part II of the Canada Labour Code and of the Aviation Occupational Health and Safety Regulations. The Headquarters Division provides guidance and assistance to Regional Civil Aviation Safety Inspectors-Occupational Health and Safety [CASI-OHS] who conduct inspections, investigations and promotional visits to ensure that air operators are committed to the health and safety of their employees.

The Code prescribes regulations[5] that address the following:

- Prevention of accidents and injuries arising out of, linked with, or occurring in the course of employment to which this part applies.
- Elimination of hazards, the reduction of hazards, the provision of personal protective equipment, clothing, devices, or materials, all with the goal of ensuring the health and safety of employees.
- A general obligation or duty to ensure that the health and safety of every person is protected while working.
- Specific duties of employers regarding each workplace they control and every work activity under their authority.

1 FAA/OSHA MOU on Occupational Safety and Health Standards for Aircraft Cabin Crewmembers. *www.faa.gov/about/initiatives/ashp/media/FAA_OSHA_MOU_2014.pdf*
2 FAA Civil Aerospace Medical Institute. *www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/cami/*
3 FAA Aeromedical Safety Bulletins. *www.faa.gov/pilots/safety/pilotsafetybrochures/*
4 Transport Canada Aviation Occupational Health & Safety Website. *www.tc.gc.ca/eng/civilaviation/standards/commerce-ohs-menu-2059.htm*
5 Transport Canada Aviation Occupational Health & Safety Regulations. *https://laws-lois.justice.gc.ca/eng/regulations/SOR-2011-87/index.html*

TC's Advisory Circular (AC) LTA-004, "Aviation Occupational Health and Safety Program,"[6] describes its basic functions and points the reader to related resources. However, like the FAA, TC does not have a comprehensive advisory circular which provides guidance concerning the procedures, equipment, and training needed to conduct an aviation occupational health and safety program.

RECOMMENDATIONS:

- The FAA and TC should convene working groups in their respective countries composed of aviation industry and labor stakeholder groups, including ALPA, to develop comprehensive advisory circulars on aviation occupational health and safety. These guidance documents should describe the hazards identified in this white paper and others, plus the recommended best practices for procedures, equipment, and training needed to address them and provide a safe and healthy aircraft work environment.

- The FAA should model its occupational health and safety program after that of TC, to include the creation of a headquarters-level division, which conducts inspections, investigations, and promotional visits to ensure that airlines are committed to the health and safety of the employees.

6 Transport Canada Advisory Circular (AC) LTA-004, "Subject: Aviation Occupational Health and Safety Program," (March 2018). *https://tc.canada.ca/en/aviation/reference-centre/advisory-circulars/advisory-circular-ac-no-lta-004*

OCCUPATIONAL HEALTH AND SAFETY ISSUES

The work environment of the airline flight deck has numerous potentially harmful attributes which can create safety risks and short- and long-term health effects. It is incumbent upon regulators and aircraft operators to fully understand and mitigate these occupational safety and health risks to the fullest practical extent. This paper addresses some of the most prevalent safety and health hazards in today's airline operating environment: cabin air quality, potable water and food safety, cleanliness and sanitation, radiation, and other flight deck health and safety risks.

CABIN AIR QUALITY

Today's most difficult and concerning onboard safety and health hazard is that of smoke and fume events in the flight deck and cabin. According to the International Civil Aviation Organization (ICAO), "Of all of [the] potential contaminants in the cabin and flight deck, particular concerns have been raised regarding the negative impact on flight safety when crew members are exposed to oil or hydraulic fluid fumes or smoke, and experience acute symptoms in flight."[7] The International Air Transport Association (IATA) states, "Much controversy exists in relation to the potential health ramifications of cabin air quality events [CAQEs], particularly for the so-called fume events, and international research continues in an effort to provide answers. Engineering efforts are also underway to try to reduce the incidence of these uncommon but concerning events. Regardless of these efforts it is important from a duty of care perspective, that airlines have a methodology of managing these events and providing appropriate care to the crew and passengers involved."[8]

There is a preponderance of various types of airborne substances, including toxins, which may be admitted into the atmosphere of the cabin and flight deck and inhaled by a crewmember or passenger, resulting in the following symptoms:

- Numbness and tingling in the extremities
- Memory loss and confusion
- Blurred vision
- Coughing that lasts 48 to 72 hours

- Breathlessness
- Headache
- Nausea
- Dizziness

Some CAQ events have led to post-flight hospitalization due to very high levels of carbon monoxide poisoning or other health issues. One important finding based on reports is that the effects of CAQ events vary from person to person and may be influenced by genetic differences, age, underlying health conditions, and the severity of the event.

On most commercial aircraft in use today, cabin air is produced by engine or auxiliary power unit compressor bleed air, which is conditioned—but not filtered—prior to reaching the inside of the pressure vessel. Due to aircraft design, operating procedures, maintenance procedures, or some combination thereof, engine oils may seep past seals, become superheated (aka pyrolyzed), and then enter the cabin air system as airborne particulates. These particulates may be readily noticed by crewmembers and passengers as smoke and/or as an odor (e.g., dirty socks) and, at a minimum, be detrimental to CAQ.

7 ICAO Circular 344-AN/202 "Guidelines on Education, Training and Reporting Practices related to Fume Events," (2015).
8 IATA Guidance for Airline Health and Safety Staff on the Medical Response to Cabin Air Quality Events. *www.alpa.org/-/media/ALPA/Files/pdfs/resources-section/secure/iata-medical-guidance-cabin-air-quality-events.pdf?la=en*

TABLE A—POTENTIAL SOURCES OF CABIN AIR CONTAMINATION

Potential Sources	Potential Impact
Engine start during push back	Exhaust gases (e.g., CO, CO_2, NO_X, fuel, particles)
Bleed air switch off during engine start	Short time increase of CO_2
Cabin cleaning in general Interior cleaning	VOC*, e.g., alcohols, flavors (terpenes), aldehydes Residual of tetrachloroethene
No ozone converters installed	Ozone, particularly in cruise
De-icing fluids	1, 2-Propanediol (major constituent) and various additives (e.g., dyes, thickener, antioxidants)
Aircraft traffic at the airport	Exhaust gases (e.g., CO, CO_2, NO_X, fuel, particles)
Car traffic at the airport	Exhaust gases (e.g., CO, CO_2, NO_X, gasoline, particles)
Passengers	Emission of CO_2, various VOCs, offensive smell
Restrooms	Smell, VOC from cleaning products
Furnishings	VOC/SVOC, particulate organ matter (POM), flame retardants, e.g., organophosphates
Maintenance	Various VOCs, lubricants
Lubricants	Oil base stock, organophosphates, POM
Hydraulic fluids	e.g., Tributyl phosphate (TBP), triphenyl phosphate (TPP)
Engine oils	Tricresyl phosphate (TCP), trixylyl phosphate (TXP), amines
In case of thermal degradation	VOCs, organic acids, aldehydes, CO, CO_2, potential unknown products

*VOC (volatile organic compound)
Source: European Union Aviation Safety Agency

As seen from Table A,[9] numerous compounds in the aircraft environment may contaminate cabin and flight deck air.

In recognition of the safety and health concerns associated with CAQ events, IFALPA, of which ALPA is a member, and the International Transport Workers Federation, recommended in 2013 that ICAO "consider the flight safety implications of crew member exposure to oil fumes sourced to the aircraft air supply system," and to develop associated guidance, awareness, and training materials for frontline aviation employees. The assembly concurred with that recommendation and subsequently developed "ICAO Cir 344-AN/202 "Guidelines on Education, Training and Reporting Practices related to Fume Events," 2015.[10]

The document contains information and recommendations concerning:

- Education of frontline aviation employees
- Training
- Standardized CAQ event reporting

9 Final Report EASA_REP_RESEA_2014_4, Research Project: CAQ Preliminary cabin air quality measurement campaign, p. 12. *www.alpa.org/-/media/ALPA/Files/pdfs/resources-section/secure/fumes/easa-caq-study-final-report.pdf?la=en*

10 ICAO Circular 344-AN/202.

- Methods to troubleshoot potential air supply-system sourced fumes
- CAQ event investigation

In 2018, IFALPA published its own briefing leaflet titled "Cabin Fumes,"[11] which provides that organization's description of CAQ considerations along with recommendations on the following:

- Bleed air certification specifications
- Crew actions in a fume event
- Reporting fume events
- Post-event procedures and medical examinations
- Crew training
- Long-term health effects
- Maintenance
- New technologies and solutions

ALPA has been actively involved in the CAQ issue since 2015 and has taken numerous steps over the years to help mitigate this problem. The Association urges pilots who encounter a fume event to report them promptly via their Safety Management System (SMS) and/or Aviation Safety Action Plan (ASAP) reporting system, which helps ensure that the FAA and the airline will learn of it and take corrective action. ALPA advocates that the airlines incorporate fields into SMS/ASAP reports which will capture the information needed to address CAQ events in a responsive fashion. ALPA provides the IATA Smoke and Fumes Reporting Form on its website (*www.alpa.org*) and urges members to complete and submit it, in addition to other forms of reporting, for follow up. ALPA also provides guidance to crewmembers who experience a CAQ event, for use by their health-care providers. The guidance is intended to help the physician provide the proper care for this type of medical emergency. As noted previously, ALPA's Air Safety Organization established a Health and Environment Working Group to chart a path forward focusing on standardized training, reporting, and other related initiatives on this topic.

Other important aspects of CAQ not related to fume events are health concerns due to high temperatures and excessively low humidity. For crew and passenger comfort and safety, flight deck and cabin air temperatures must be well regulated to prevent the potential for heat exhaustion and/or dehydration, especially during ground operations; the FAA has documented methods for doing so in an advisory circular.[12] Bleed air systems provide very dry air to the aircraft interior, which can contribute to such maladies as deep vein thrombosis, the development of kidney stones, and other health effects.

Although a much less serious form of CAQ contaminant, high levels of ozone, a colorless gas which forms near the ground when pollutants such as jet engine exhaust react chemically in sunlight, can also be a health issue, most typically in summer months. Health effects that could be experienced during ground operations when ozone levels are high, and particularly during the preflight inspection, and may include aggravation of asthma, difficulty breathing, heightened sensitivity to allergens, and airway inflammation.[13]

Other toxic contaminants that can foul the air in the flight deck and cabin, and create the potential for adverse health effects come from such activities as aircraft disinsection, aircraft disinfection, use of windscreen rain repellent, and aircraft deicing with various glycol-based fluid compounds. Aircraft disinsection, performed by spraying insecticides in the aircraft, is conducted in certain parts of the world to protect public health, agriculture, and the environment. The U.S. Department of Transportation states that if disinsection is performed appropriately, it does not pose a health risk, but also notes that some individuals may experience "transient discomfort" if the insecticide is sprayed as an aerosol.[14]

RECOMMENDATIONS:

- Although there are tests which can be administered by health-care professionals to identify the presence of carbon monoxide in the blood stream (e.g., carboxyhemoglobin and arterial blood gasses), there are no tests which positively indicate the presence of the toxic compounds produced by pyrolyzed aviation engine fluids and lubricants in the human body. Government-sponsored medical research should be performed to determine (1) tests which will detect the presence of these chemicals in the blood after a CAQ event and (2) document the health risks that the chemicals have on humans at various levels of acute and chronic exposure.

11 IFALPA Human Performance Briefing Leaflet "Cabin Fumes," (December 5, 2018). *https://ifalpa.org/media/3141/18hupbl03-cabin-fumes.pdf*

12 FAA Advisory Circular 121-35, Management of Passengers During Ground Operations Without Ventilation (1/16/03). *http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/df84251444234753862 56cb0005cdc20/$FILE/AC121-35.pdf*

13 Ozone and Your Health. Environmental Protection Agency. *www.epa.gov/sites/production/files/2015-06/documents/ozone_and_your_health.pdf*

14 DOT Aircraft Disinsection Requirements. *www.transportation.gov/airconsumer/spray*

- Smoke, fume and fire detection and protection systems should be installed in all current and future transport category aircraft to protect the safety of flight in the event of smoke, fire, and fume events. Full-face oxygen masks should be mandatory as well as equipment that enables both pilots to see the instrument panel and beyond the windshield to land the aircraft during events when the flight deck is filled with smoke generated continuously. ALPA's full policy statement on this subject is provided in Appendix A.

- Air quality and contamination sensors should be installed in all current and future transport category aircraft. While currently available sensor technology only permits periodic reading downloads, the option for real-time inflight monitoring by flight crews should be developed and implemented.

- Aircraft manufacturers should develop engine and systems technologies which will prevent the introduction of aircraft oils and lubricants into bleed air systems to preclude the potential for health effects from that source.

POTABLE WATER AND FOOD SAFETY

In 2004, the U.S. Environmental Protection Agency (EPA) found all aircraft public water systems (PWS) to be out of compliance with the national primary drinking water regulations (NPDWRs). Fifteen percent of the 327 aircraft PWS which were examined tested positive for total coliform. The finding of noncompliance caused the EPA to place 45 U.S. airlines under temporary rules called "administrative orders on consent and request for information," until such time as the agency could write new regulations for oversight of the aircraft PWS. The new aircraft drinking water rules (ADWR) were published in 2009 and became effective in 2011.

The NPDWRs were designed for traditional stationary public water systems, not mobile aircraft water systems that are operationally very different. Unlike stationary water systems, those on aircraft board water using temporary connections to internal tanks, and the quality of the water provided to passengers and crews onboard the aircraft depends on proper training, operation, and maintenance of the end-to-end water supply system and process, including water transfer equipment (e.g., water cabinets, trucks, carts, and hoses).

The EPA's ADWR applies only to the aircraft's onboard water system. The U.S. Food and Drug Administration (FDA) regulates all the external components from which the onboard system is supplied drinking water. However, the EPA and the states are responsible for regulation of public water systems, from which drinking water is supplied to airport watering points. The EPA table on page 11 depicts the potential contamination pathways for drinking water from a public water system source to aircraft lavatories and galleys.

EPA regulation 40 CFR §140 contains numerous requirements for airlines to provide aircraft drinking water, including:

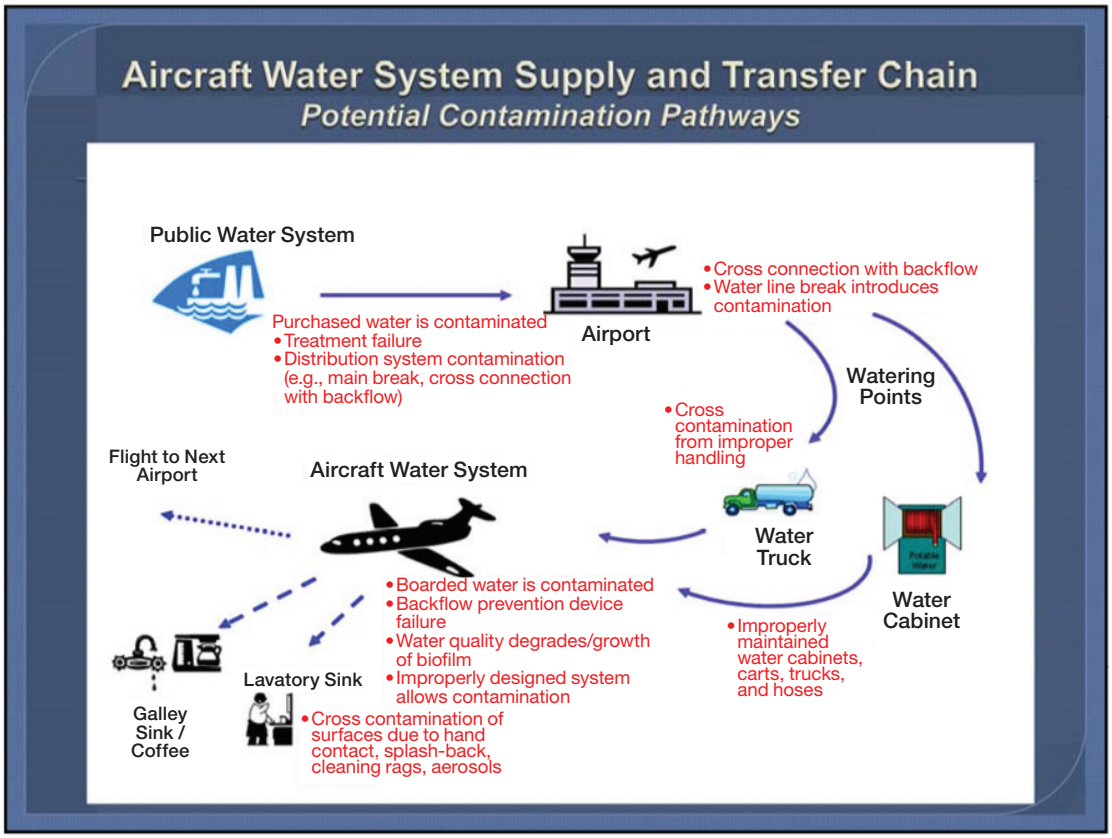
- Training for all personnel involved with the aircraft water system operation and maintenance provisions of the regulation, which includes boarding water procedures, sample collection procedures, disinfection and flushing procedures, and the EPA's public health and safety requirements.

- Notification to passengers and crews in a variety of circumstances including those in which there is a positive test for coliform or E. coli; a failure to properly disinfect, flush, or collect required routine samples; or an E. coli–positive event resulting from boarded water on a particular aircraft. An October 2009 EPA fact sheet on the final aircraft drinking water rule provides further particulars about these tests and requisite cleanings, flushings, and public notifications.[15]

- Making periodic reports to the EPA concerning the outcomes of their aircraft-specific tests and keeping records of their findings. These reports can be viewed on EPA's website.

- Developing a coliform sampling plan for each aircraft water system, to include the frequency and number of routine coliform samples and the frequency of routine disinfection and flushing. Two coliform samples are taken per monitoring period: one from a lavatory and one from a galley. Any finding of total coliform requires further analysis for the presence of E-coli and disinfection and flushing of the aircraft water system. The regulation includes the disinfection and flushing frequencies for aircraft operators listed in Table B.

15 EPA "Fact Sheet: Final Aircraft Drinking Water Rule," (October 2009). *https://nepis.epa.gov/Exe/ZyPdf.cgi?Dockey=P1005C21.txt*



Source: EPA

In Canada, the "Canada Labour Code, Part II" is the regulatory framework that ensures that the health and safety of all employees who are under federal jurisdiction while at work are protected. Concurrently, the regulations implemented by the legislation titled the "Department of Health Act" is responsible for the protection of public health on aircraft. Therefore, air operators have regulated responsibilities to their employees and passengers that ensure that potable water systems onboard aircraft are installed and maintained in the manner prescribed. To that end, air operators with potable water systems on board aircraft are to ensure that they are in compliance with the Public Health Agency of Canada's "Potable Water Regulations for Common Carriers."

To remind air operators of their responsibilities in this regard, Transport Canada published a Commercial and Business Aviation Advisory Circular (CBAAC #0208) entitled "Air Operators' Responsibilities with Respect to Potable Water Systems On Board Aircraft."

The CBAAC recommends that air operators develop a comprehensive water quality management program to deal with potable water quality onboard aircraft, the transfer of water from source to airport, and from airport to aircraft.

A 2019 study[16] of aircraft drinking water conducted by the City University of New York's Hunter College NYC Food Policy Center produced some unsettling results. The research ranked 10 major and 12 "regional" airlines in the United States, based on potable water quality using 10 criteria, including the presence of E. coli and coliform in the water, and number of other EPA violations, on a scale of five to zero. According to the researchers' metrics, a score of 3.0 or greater demonstrates that an airline has "relatively safe, clean water." The scores for the 10 major U.S. airlines ranged from 3.3 to 1, with an average score of 2.1. The scores of the 12 regional U.S. airlines ranged from 4.33 to .44 with an average score of 1.6.

The scores are so low that the researchers made the following recommendations: "To be extra safe, never drink any water onboard that isn't in a sealed bottle, do not drink coffee or tea onboard, [and] do not wash your hands in the bathroom; bring hand-sanitizer with you instead." On some transport aircraft, sanitary wipes are provided in the lavatories for those which do not have potable water onboard for hand washing, even though hot soapy water is the recommended method of ensuring hygiene after using the lavatory and before food preparation.

16 2019 Study on Aircraft Potable Water by CUNY. *www.eurekalert.org/pub_releases/2019-08/tcuo-2aw082919.php*

TABLE B—ROUTINE DISINFECTION AND FLUSHING AND ROUTINE SAMPLE FREQUENCIES

Minimum routine disinfection and flushing per aircraft	Minimum frequency of routine samples per aircraft
At least four times per year = at least once within every three-month period (quarterly)	At least once per year = at least once within every 12-month period (annually)
At least three times per year = at least once within every four-month period	At least twice per year = at least once within every six-month period (semiannually)
At least twice per year = at least once within every six-month period (semiannually)	At least four times per year = at least once within every three-month period (quarterly)
At least once per year or less = at least once within every 12-month period (annually) or less	At least 12 times per year = at least once every month (monthly)

AIRLINE FOOD SAFETY

The safety of food served onboard airline aircraft is not only a health issue, it is also an important safety issue. A circumstance in which an operating crewmember encounters food poisoning poses an immediate threat to the safety of flight operations. A diversion may be necessitated by the other pilot(s) onboard who has not been affected, which brings to bear all the safety ramifications of single-pilot operations of an aircraft type certificated to be operated by two pilots.

One of numerous pilot reports to NASA's Aviation Safety Reporting System (i.e., ACN: 477167) concerning inflight incapacitation from crew meals demonstrates the flight safety implications of this risk:

> "ABOUT 30 MINS AFTER HIS MEAL, FO BECAME VERY ILL. MEDICAL RECOMMENDED LNDG. DECLARED EMER. LANDED OVERWT 34500 LBS, FLAPS 20 DEGS, NORMAL TOUCHDOWN AT ORD … FO TAKEN TO HOSPITAL. FOOD POISONING. CAPT AND FO DID NOT CONSUME SAME MEAL. SYNOPSIS: PLT INCAPACITATION ENRTE. DIVERSION AND OVERWT LNDG."

The FDA is responsible for regulating the safety of food prepared for commercial use, which includes the airlines. The regulations for this purpose are at 21 CFR, Food and Drugs, Part 1250, Interstate Conveyance Sanitation. These regulations address the areas of food service sanitation, equipment, and operation; servicing areas for conveyances; and sanitation facilities and conditions on vessels. The FDA enforces these regulations through inspections. In Canada, Sections 4.14–4.21 of *the Aviation Occupational Health and Safety Regulations* dictate in general terms how food should be handled onboard aircraft.

Cabin crewmembers are given "customer service" training, which includes procedures for food handling, storage, heating, cooling, and waste disposal. However, the depth of this training varies from airline to airline, and cabin crews may not be provided the tools needed to make accurate verifications of food temperatures and safety.

RECOMMENDATIONS:

- The aircraft is a public transportation conveyance on which water, meals, and drinks are served. In that regard, it shares commonality with restaurants, which are required by state and municipal laws to conspicuously post the results of their sanitation inspections. The FAA, EPA, and FDA should coordinate on the development of a public website which publishes the results of the U.S. government's ongoing food and potable water safety inspections for all FAR Part 121 airlines, including all-cargo operators.
- All crewmembers who are responsible for food preparation and service should receive training on food safety to commercial food preparation standards. Airlines should also provide those crewmembers with needed equipment (e.g., food thermometers, food-safe temperature charts, etc.) and training on how to use the equipment.
- All transport category passenger and cargo aircraft should have hot and cold running potable water plumbed to lavatory sinks, with soap furnished, for use by passengers and crewmembers.

CLEANLINESS AND SANITATION

IN-FLIGHT TRANSMISSION OF COMMUNICABLE DISEASES, SANITATION

History has demonstrated that communicable diseases of many kinds can have devastating impacts on the health and economies of nations, including, and for purposes of this paper, commercial aviation. A suite (or playbook) of proactive health and sanitization resources should be available to the airlines for use during all stages of a communicable disease outbreak to limit their harmful impacts to the greatest possible extent. In a low-risk environment, aircraft cleaning and sanitizing may be all that is required, while during an outbreak, additional measures may be required to include physical distancing, taking temperatures before boarding, etc.

The development and adoption of sound guidance on the cleaning and disinfecting of aircraft can make positive contributions to the safety and well-being of all airplane occupants and help increase confidence in air travel as a mode of transportation. Under the auspices of an RTCA Special Committee 241 and European Organisation for Civil Aviation Equipment (EUROCAE) Working Group 121 and participation of many others, standardized guidance was developed for the benefit of the global airline industry on this subject.[17]

In the United States, the Centers for Disease Control and Prevention (CDC) is responsible for protecting public health by preventing the spread of communicable diseases from foreign countries into the United States. CDC personnel working at quarantine stations located at or near major U.S. ports of entry may board an arriving airplane to assess an ill traveler and make recommendations about exposure risks to others. The CDC publishes information for use by the airline industry on the prevention of spreading disease on commercial aircraft.[18] The World Health Organization also publishes guidance on potable water and cleaning and disinfection of aircraft and airport facilities.[19]

CONTAMINATION OF FLIGHT DECK OXYGEN MASKS

The airline industry has a practice of sharing oxygen masks among multiple users in aircraft flight decks and in training simulators. These procedures may place pilots at increased risk for contracting a transmissible disease, which arise due to the mask's inherent inability to be properly disassembled and cleaned between users. According to the NIOSH and CDC, proper precautions for respirator cleanliness involves a six-step disassembly and disinfection process between each user. The respirator must be taken apart and immersed in a disinfectant solution in order to reach all crevices. Currently, aviation oxygen masks cannot be disassembled to this degree due to their electronics and microphone components. Furthermore, oxygen masks are not defined as respirators, so are not addressed by sanitation regulations. The use of a disposable paper insert which would be replaced after each simulator training session could greatly reduce the transmission of disease.

An ALPA white paper entitled *"Oxygen Mask Use in Aviation"* (2009), elaborates on this particular sanitation need and recommended that the best solution to resolving the problem was a change to 14 CFR Part 121.333(cc)(3) to require the use of the oxygen masks above flight level 410 instead of 250. In 2018 and with ALPA's urging as part of the FAA's Reauthorization legislation, Congress included a requirement that the FAA issue a rule to require this change by October 5, 2019. While the FAA missed that original deadline, the regulation was amended and went into effect March 23, 2020.

RECOMMENDATIONS:

- Airlines should make use of disposable paper inserts which would be replaced after each simulator training session. This is a very low-cost, but effective, solution to the problem in the training environment and should be implemented.
- The FAA should require that oxygen masks be cleaned after they have been used in flight. It may be necessary to redesign masks to allow disassembly and immersion in disinfecting solutions. The FAA should work with original equipment manufacturers to conduct research to identify new oxygen mask designs and/or methods of mask disinfection which do not require disassembly.

RADIATION

Low levels of ionizing radiation are a normal part of the environment, and substances that emit ionizing radiation are present in each cell of the body. Humans are also exposed to cosmic radiation which originates from outside the solar system—known as galactic cosmic radiation—and from the Sun—known as solar cosmic radiation.

17 "Guidance Document on Aircraft Cleaning and Disinfection," RTCA DO-338, *www.rtca.org*

18 Preventing Spread of Disease on Commercial Aircraft: Guidance for Cabin Crew. *www.cdc.gov/quarantine/air/managing-sick-travelers/commercial-aircraft/infection-control-cabin-crew.html*

19 "Guide to Hygiene and Sanitation in Aviation," Third Edition. World Health Organization (2009). *www.who.int/water_sanitation_health/hygiene/ships/guide_hygiene_sanitation_aviation_3_edition.pdf*

The amount of cosmic radiation which a crewmember experiences is primarily dependent on four factors: altitude, latitude, normal solar activity, and solar events. The amount of radiation is about 100 times greater at airline cruise altitudes than on the ground. The Earth's magnetic field normally shields us from much of the effects of that radiation, but this shielding decreases with an increase in latitude. The sun's radiation activity varies predictably over a cycle of about 11 years. When solar activity is higher, cosmic radiation levels decrease and vice versa, because the Sun's magnetic field deflects radiation away from the earth. Solar events, also called solar flares, occur when a severe disturbance creates an increase in radiation outputs. These events range in duration and can last a few minutes, or for more than a day. The radiation increase is greatest at the magnetic poles where the magnetic field is weakest, and it is lowest at the equator.

Radiation exposure is usually expressed in terms of "sieverts." One sievert equals 1,000 millisieverts (mSv). The FAA's recommended limit for an aircrew member over a five-year average is 20 mSv per year, with no more than 50 mSv in a single year.[20] An average member of the U.S. population receives 3 mSv of ionizing radiation from all sources annually; pilots receive on average an additional 3 mSv each year for a total of 6 mSv, which is well below the FAA-recommended maximum exposure. Computer-based models developed by government regulators and private entities can be used to help the individual determine the amount of solar cosmic radiation, measured in mSv, that a particular route(s) at a given altitude and time-at-altitude creates.

The FAA and TC define crewmembers as being occupationally exposed to radiation depending on the level of their exposure. Both regulators maintain websites[21] with numerous resources for additional information on this subject, which may be used by the airlines to train their employees on inflight radiation exposure risk. Neither regulator requires that the airlines provide radiation exposure training or programs for employees, but TC in 2001 stated its intention to do so in the future. TC recommends that aircraft operators develop programs to manage radiation exposure of crewmembers based on the likelihood of exceeding an exposure of 1 mSv annually and keep a permanent record of each employee's dosage in Canada's National Dose Registry. Recommended measures are contained in Advisory Circular 0183R.

The European Union has a law[22] which limits exposed workers to 100 mSv over a period of five consecutive years, not to exceed 50 mSv in any one year. Each EU member state must take reasonable steps to ensure that exposure of the population to radiation is kept as low as reasonably achievable, and the law stipulates other related measures.

Studies have raised questions about the increased susceptibility of airline pilots to ultraviolet (UV) radiation and its accompanying relationship to greater risk of skin cancer, including melanomas. According to ALPA's Aeromedical Office, "aircraft windscreens and canopies generally do not allow significant UV radiation to penetrate [the flight deck][23]." For that reason, the subject of UV radiation is beyond the scope of this paper, but it is a significant personal health issue for the pilot population regarding non-work-related outdoor activities.

Pregnant crewmembers and others who are concerned about the potential health impacts of inflight cosmic radiation dosages should consult with their physicians on the need for personal mitigations.

RECOMMENDATIONS:

- The FAA and TC should require airlines to use the most current versions of available radiation software (e.g., CARI-7) to calculate the effective dose of galactic cosmic radiation received by individuals on specific routes and make that information available to crewmembers.
- FAA and TC should also establish limits of exposure to radiation for airline crewmembers. Lower exposure limits should be established for pregnant crewmembers due to the adverse effects of radiation dosages on the fetus, as documented in a 1990 study performed for the FAA's Office of Aviation Medicine. Once these limits are established, airlines should be required to track and record employee radiation dosages and make the information concerning each employee available to them.
- Airlines should train crewmembers on the effects of cosmic radiation, ways to measure their exposure to it, and methods for limiting their personal dosages.

20 FAA Advisory Circular (AC) 120-61B, In-Flight Radiation Exposure (November 21, 2014). *www.faa.gov/documentLibrary/media/Advisory_Circular/AC_120-61B.pdf*

21 FAA Website: Reports on Radiation Exposure During Air Travel. *www.faa.gov/data_research/research/med_humanfacs/aeromedical/radiobiology/reports/*
Transport Canada Website: Cosmic Radiation. *www.tc.gc.ca/eng/civilaviation/standards/commerce-ohs-radiation-2063.htm*

22 European Union Council Directive 96/29/Euratom (May 13, 1996). *https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013L0059&from=en*

23 "Skin Cancer and Melanoma," ALPA Aeromedical Office. *www.aviationmedicine.com/article/skin-cancer-and-melanoma/*

OTHER FLIGHT DECK HEALTH AND SAFETY RISKS

LASER AND OTHER ILLUMINATION HAZARDS

There are thousands of aircraft laser strikes each year in North America. It is a critical safety issue composed of different hazard elements, and pilots require up-to-date guidance to determine what actions should be performed to maintain safety of flight and personal health. The potential negative safety and health effects of a laser striking the retina of the human eye and interfering with flight operations are well documented.

There has yet to be an aviation accident attributable to a laser illumination; however, several significant cases of pilot injury have been reported. Most aircraft laser illuminations have occurred during critical phases of fight (i.e., approach, landing, and takeoff) in the hours of darkness.

Laser illumination of the flight deck frequently produces a "startle response" in pilots that can lead to distraction and disruption of attention to aircraft control. In several reported events, laser illuminations have led to temporary disorientation or temporary incapacitation (e.g., flash blindness). In view of the worldwide proliferation of handheld lasers, the threat associated with laser strikes will continue in the United States and Canada, and elsewhere in the world.

Understanding the threat and mitigations will aid a flight crew's ability to plan ahead and produce a well-managed response to an event while protecting both the flight crew and preserving the safety of the flight. Laser-safe eyewear to be worn by pilots during critical phases of flight is commercially available. Additional informative materials on this subject, including laser incident report forms and suggested actions on how to seek medical attention, are provided on the FAA,[24] TC,[25] and ALPA[26] websites. All three organizations have strongly advocated for the safe use of handheld lasers and for measures to penalize those who intentionally point a laser at an aircraft.

Another type of light hazard which can impact aviation safety is that produced unintentionally by lighting installations and reflective materials on the ground. Large, lit billboards and signs; stadium lights; solar panels; reflective glass on skyscrapers; and other forms of light-producing materials can illuminate or reflect bright light into the flight deck of aircraft during low-altitude operations and cause temporary visual impairment during critical periods of flight. Although local zoning is the best way to prevent incompatible land use, the FAA and TC should assist in the establishment and enforcement of rules to prevent such light sources from becoming flight safety hazards during the lighting/equipment installation-planning phase, if at all possible, but at any time thereafter, also.

FLIGHT DECK AMBIENT NOISE

Pilots are exposed to loud aircraft-related noise beginning with their very first training flight, and it continues throughout their careers. Extremely loud noise from surrounding aircraft engines and auxiliary power units necessitates hearing protection for pilots doing walk-arounds and at other times on the ramp. The flight deck of a transport category aircraft is located well ahead of aircraft engines, which are the primary sources of noise generation. However, flight deck noise emanates from many other sources including airflow around the fuselage, landing gear, wings and control surfaces, aircraft equipment and systems, and flight deck warnings, alerts, radio communications, and more. Pilots may take steps to protect their hearing using ear plugs, headsets (with or without active noise-cancelling capability), or both.

The U.S. Government Accountability Office (GAO) conducted a study in 2017 of pilot and flight attendant exposure to noise aboard aircraft. As part of that study, GAO examined 10 studies of measured noise levels in aircraft cabins and flight decks published by various government and private-sector organizations between 1994 and 2012. These studies confirmed that flight decks and aircraft cabins can experience high levels of sustained noise, but the agency concluded that flight deck and cabin ambient noise levels "likely" do not exceed the OSHA standard.[27]

Whether ambient flight deck noise is experienced at a level which meets the OSHA threshold for harm or not, requirements for protection is certainly of interest for the purposes of protecting crewmembers' hearing. However, the effects of sustained loud noise may have impacts beyond those of hearing impairment. According to OSHA, "Loud noise can create physical and psychological stress, reduce productivity, interfere with communication and concentration, and contribute to workplace accidents and injuries by making it difficult to hear warning signals. The effects of noise induced hearing loss can be profound, limiting your ability to hear high-frequency

24 FAA Guidance Material on Laser Strikes and Laser Eye Protection. *https://www.faa.gov/about/initiatives/lasers/*

25 Transport Canada Laser Safety Website. *www.tc.gc.ca/en/services/transportation-security/aviation/hand-held-lasers-legally-safely.html*

26 ALPA Laser Mitigation Website. *http://aso.alpa.org/LaserMitigation/tabid/9838/Default.aspx*

27 U.S. GAO Letter to Representative Peter DeFazio (November 15, 2017). *www.gao.gov/assets/690/689099.pdf*

sounds, understand speech, and seriously impairing your ability to communicate."[28]

The CDC agrees that sustained loud noise can threaten more than just hearing acuity:

> "In addition to damaging hearing, loud noise can cause other physical stress as well as mental stress. Often the short-term effects of such stress go unnoticed or are blamed on other things. These symptoms can range from feeling tired and/or irritable to having temporarily high blood pressure or muffled hearing. Over time, with repeated exposure to loud noise, more lasting conditions can develop, such as hearing loss [a permanent condition], and it is unknown if these exposures may also lead to more lasting cardiovascular conditions, such as high blood pressure. While it has been established that noise causes hearing loss, there is new research exploring whether noise can also contribute to high blood pressure, high cholesterol and heart disease."[29]

In the United States, the FAA is responsible for regulating and taking steps to address excessive ambient noise levels in the flight deck and during ground operations. As previously noted, OSHA assumed responsibility for regulating aircraft cabin ambient noise in 2013. The FAA maintains regulatory authority for occupational noise in the flight deck, but does not have regulations that prescribe maximum values for frequency, intensity, and duration. An FAA CAMI paper on the subject[30] states that, "If the ambient noise level exceeds OSHA's permissible noise exposure limits, you should use hearing protection devices—earplugs, earmuffs, communication headsets, or active noise reduction headsets."

OSHA regulation 1910.95(c)(1) requires employers to administer an ongoing hearing conservation program whenever employee noise exposures are at or above an eight-hour time-weighted average sound level of 85 decibels.[31] Airlines may mandate noise-reduction measures for their affected crewmembers, but neither the FAA nor TC require that they do so. GAO determined that some airlines allow earplugs and noise-reducing headsets and/or provide them for pilot use.

The FAA requires manufacturers to take ambient noise and vibration into consideration during the design of transport category aircraft. Federal Aviation Regulation 14 CFR 25.771(e) states, "vibration and noise characteristics of [flight deck] equipment may not interfere with safe operation of the airplane." The measure of interference with safety, however, is highly subjective and is dealt with on a case-by-case basis by the FAA and manufacturers during aircraft certification. The FAA does not require the use of hearing protection in the Federal Aviation Regulations but does reference OSHA standards in this regard.[32]

Section 2.4 to 2.8 of Transport Canada's Aviation Occupational Health and Safety Regulations specifies noise limits of exposure and, if those limits are exceeded, employers are required to provide hearing protectors.

RECOMMENDATIONS:

- The FAA and TC should, in coordination with their respective country's airlines, measure ambient flight deck noise on all types of passenger and cargo aircraft at various altitudes and speeds during normal line operations. Such research would be aimed at developing a more informed understanding of ambient noise experienced by crewmembers on the line. After initial baseline measurements, each aircraft type should be retested after 5, 10, 15, and 20 years of service to chart the possible degradation of sound-dampening capabilities.
- U.S. and Canadian governments should conduct research on the nature of flight deck noise and the long-term effects of that noise on pilot hearing loss. Based on the research outcomes, the following initiatives, to include metrics on frequency, intensity, and duration, should be established as soon as possible:
  - A design standard for the maximum acceptable level of noise in the flight deck under all normal operating conditions
  - A threshold beyond which specified noise-mitigation measures are required

28 OSHA Occupational Noise Exposure Health Effects. *www.osha.gov/SLTC/noisehearingconservation/healtheffects.html*
29 CDC NIOSH Science Blog. "Workplace Noise: More Than Just 'All Ears.'" (June 28, 2018). *blogs.cdc.gov/niosh-science-blog/2018/06/28/noise-effects/*
30 FAA Brochure "Hearing and Noise in Aviation." *www.faa.gov/pilots/safety/pilotsafetybrochures/media/hearing.pdf*
31 OSHA Regulation 1910.95 - Occupational Noise Exposure. *www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.95*
32 FAA Brochure "Hearing and Noise in Aviation." *www.faa.gov/pilots/safety/pilotsafetybrochures/media/hearing.pdf*

APPENDIX A

ALPA POLICY ON IN-FLIGHT SMOKE, FIRE, FUME EVENTS

AMENDED—EXECUTIVE BOARD OCTOBER 2013

1. ALPA shall advocate requirements for the installation of smoke and fire detection and protection systems in all current and future transport category aircraft having, as a minimum, the following general characteristics:

    a. Detection and protection provided throughout the entire aircraft.

    b. The capability for temperature trend-monitoring.

    c. The capability to specifically identify from within the cockpit, the location of heat, fire, and/or smoke throughout the entire aircraft.

    d. The capability for continuous cockpit trend-monitoring during suppression attempts to provide accurate feedback to the flight crew regarding location of high temperatures, fire, and smoke, and the discharge and status of the extinguishing agent.

2. ALPA shall advocate for both cargo and passenger airline operations, industry-wide adoption of the 2005 Flight Safety Foundation standardized smoke/fire/fume checklist procedures that make landing the aircraft (divert, ditch, return-to-base, off-airport, etc.) an initial flightcrew consideration after the annunciation or evidence of smoke/fire/fumes.

3. The flight crew must be provided means that will allow continued Safe Flight and Landing with cockpit smoke generated continuously. Continued Safe Flight and Landing means the capability for continued controlled flight and landing at a suitable airport (e.g., the flight crew needs to be able to see the instrument panel and beyond the windshield to land the aircraft), possibly using emergency procedures, but without requiring exceptional pilot skill or strength. Some airplane damage may be associated with a failure condition during flight or upon landing.

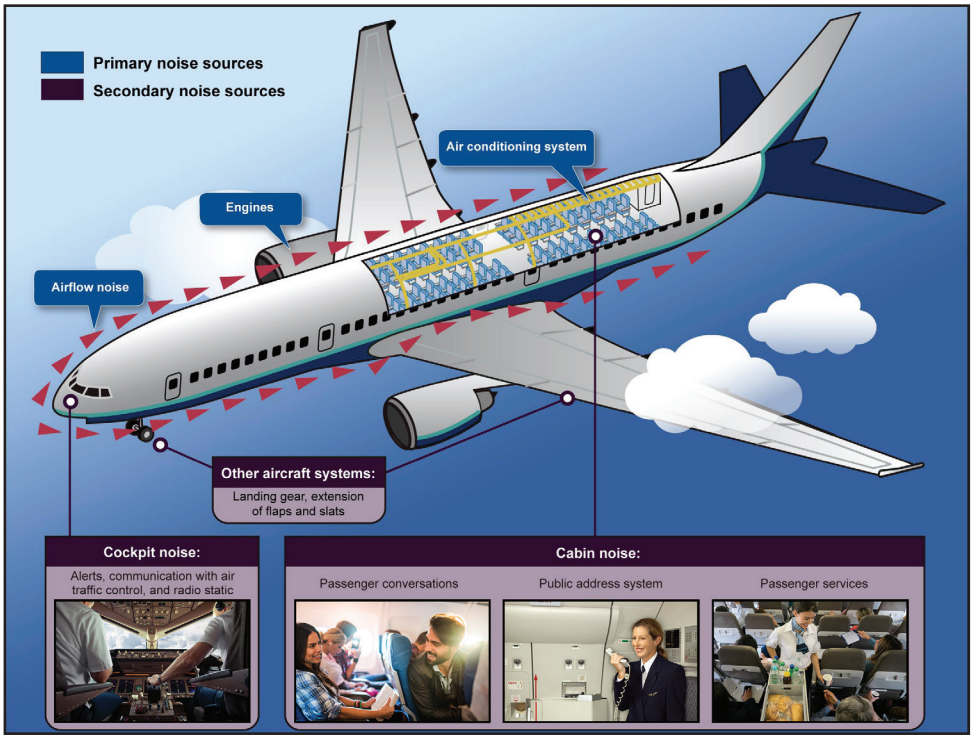
4. Each flight crewmember should be provided with a full-face, quick-donning oxygen mask that has the following additional features:

    a. Capability to purge smoke from inside the mask;

    b. Capability to select 100% oxygen and either diluter-demand or pressure-demand for smoke/fume protection;

    c. Provide a positive indication of oxygen flow to the mask;

    d. Oxygen supply lines, at each flight crewmember station oxygen mask, of sufficient length such that controls, switches, and emergency equipment on the flight deck necessary for continued safe flight and landing can be accessed without removing the mask, disconnecting the supply line, or having the mask unseal from the flight crewmember's face.



NOTES

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