

[Rep. Mazie Hirono asked the Federal Aviation Administration questions during a February 11, 2009 Transportation and Infrastructure Aviation Subcommittee hearing. What follows is the FAA's reply. Following this reply is a rebuttal to the reply.]

Mandatory Requirements for Smoke in the Cockpit

Issue Summary

Senator Inouye and Rep. Hirono of Hawaii have both asked the FAA about why the FAA does not require a particular piece of equipment in all military and civilian transport aircraft to mitigate “unstoppable blinding smoke in the cockpit.” Rep. Hirono has cited “numerous catastrophic fatal airliner incidents in which smoke in the cockpit has been a cause or a factor of that incident” to justify this amendment.

Although the current FAA Reauthorization Bill from the House (HR 915) does not include any language on smoke in the cockpit, a proposed amendment has been drafted. The amendment:

- 1) defines “continuous and unstoppable opaque smoke in the cockpit” as an unsafe condition;
- 2) requires all new Parts 121 and 135 aircraft install specific equipment to mitigate these conditions;
- 3) requires retrofits of all Part 121 and 135 aircraft with this special equipment; and
- 4) prohibits any Part 121 or 135 aircraft from landing in the United States without this equipment.

Background /Additional Information

Although in the past, there have been incidents where commercial aircraft have had to make emergency landings due to what was later reported as smoke in the cockpit, no accidents or catastrophic events can be tied solely to the presence of smoke in the cockpit. In fact, since 1990, only three fatal accidents – all from 1996 – cited smoke in the cockpit at all. There are numerous systems and procedures in place to both prevent and mitigate smoke in the cockpit. Today’s passenger-carrying aircraft are designed with ventilation systems capable of efficiently evacuating smoke from the cockpit. Trained flight crews are well versed in handling incidents of smoke in the cockpit. All cockpits have emergency equipment that includes quick-don oxygen masks for breathing, smoke goggles that allow pilots to see the instruments, and fire extinguishers.

The FAA does not discourage operators from installing systems to aid pilots’ vision in cases of smoke in the cockpit. We have certified and approved this equipment for optional installation on over 100 aircraft models. The first such approval, for the Emergency Vision Assurance System (EVAS) was issued to Vision Safe, Inc., in 1990. It is approved for installation on over 100 aircraft models. However, EVAS, or any similar system, is not required for safe operation of an airplane. Therefore, the

installation of EVAS, or any similar system, remains an equipment option, available to operators based on their assessed needs.

In addition, the language suggests that the FAA deny non-compliant foreign-registered aircraft permission to land at U.S. airports. Imposing a requirement on foreign carriers suggests that the FAA intends to enforce the requirement through surveillance. This would open up our carriers to retaliation from other countries to enforce requirements of their choosing on our operators. Language such as this must be reserved for true cases of adverse safety, with supporting data indicating U.S. citizens' lives are in jeopardy. There is no such data for this proposal.

This proposed language could have the effect of restricting the FAA's ability to take appropriate safety actions when necessary. Title 14 U.S. Code of Federal Regulations, Part 39, Airworthiness Directives, provides the legal framework for the FAA to issue corrective actions for unsafe conditions found in aviation-related products. By defining the term "unsafe condition," it is likely a condition could arise that poses a safety risk, but somehow that condition does not fit the proposed definition. The FAA must preserve the latitude to define an unsafe condition on a case-by-case basis, using all pertinent available data.

There is no data, in-service or otherwise, to warrant defining "continuous unstoppable opaque smoke" as an unsafe condition. It is an abnormal condition. The presence of smoke in a cockpit is a side-effect of an underlying defect in a component or system and can be mitigated by the crew, using aircraft systems and equipment and by employing effective crew procedures.

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[The rebuttal to the FAA's response Rep. Mazie Hirono follows in the next page. The FAA's comments are in black, the rebuttal is in blue.]

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Although the current FAA Reauthorization Bill from the House (HR 915) does not include any language on smoke in the cockpit, a proposed amendment has been drafted. The amendment:

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- 4) prohibits any Part 121 or 135 aircraft from landing in the United States without this equipment.

With respect to the FAA’s comments 2-4 above, there is nothing in the proposed legislation that specifies a particular piece of equipment. It only requires that continuous pilot vision exist on the aircraft especially, during the unsafe conditions of accumulation of unstoppable, dense, blinding smoke in the cockpit.

Background /Additional Information Although in the past, there have been incidents where commercial aircraft have had to make emergency landings due to what was later reported as smoke in the cockpit, no accidents or catastrophic events can be tied solely to the presence of smoke in the cockpit.

The NTSB has addressed smoke in the cockpit as a threat for decades. It has been a cause or a factor in numerous accidents. Recommendations have been made to the FAA to eliminate this unsafe condition. The only significant actions the FAA has made were to (1) instruct pilots to land as soon as possible when the smoke cannot stop the smoke, and (2) install emergency vision equipment on its VIP aircraft.

As recently as 2007, the NTSB wrote that “[t]he Board considers any kind of fire and/or smoke in the cockpit to be a serious issue that could affect other aircraft systems, lead to a loss of visibility, provide a distraction, or incapacitate the crew and possibly lead to an accident.”¹

Regarding the FAA’s sentence above, it is factually incorrect. There have been accidents tied solely to the pilots’ inability to see due to smoke. There have been numerous others in which smoke was a significant factor.²

The FAA’s sentence above is carefully worded. It states that, “no accidents or catastrophic events can be tied solely to the presence of smoke in the cockpit.” In most airline crashes there are a series of events so the statement “tied solely” would work in virtually all accident investigation. For example, I believe it would be correct to state that no fatality in a forced water landing can be tied solely to

the airline's failure to have life vests. Nevertheless, life vests are on airliners as a last ditch safety device. When pilots get continuous blinding smoke in the cockpit, a last ditch ability to see is as reasonable as having seldom used life vests.

In fact, since 1990, only three fatal accidents – all from 1996 – cited smoke in the cockpit at all.

This is a distortion of the fact that, as mentioned earlier, the NTSB has asked the FAA to fix—the unsafe conditions relating to smoke in the cockpit—for the last 40-50 years. Current equipment and procedures do not enable pilots to see when dense, blinding smoke cannot be stopped.

Accepting, *arguendo*, (and only for the sake of argument) that the FAA's statement above is accurate; the facts it asserts violate the FAA's own regulations. FAA regulation 14 CFR § 25.1309 and its implementing Advisory Circular 25.1309-1A, describe one of the requirements regarding airliner equipment, systems, and installations for their certification.

“(a) The equipment, systems, and installations whose functioning is required by this subchapter,* must be designed to ensure that they perform their intended functions under any foreseeable operating condition.” (Emphasis added)

We can assume that continuous smoke is foreseeable for at least two reasons. First, it has happened before. Second, the FAA has it on its aircraft and would not if continuous smoke were not foreseeable.

Regulation §25.1309 continues:

“(b) The airplane systems and associated components, considered separately and in relation to other systems, must be designed so that— (1) The occurrence of any failure condition which would prevent the continued safe flight and landing of the airplane is extremely improbable. . . .” (Emphasis added)

We have emphasized two terms of art. The first is “continued safe flight and landing.” To the FAA this phrase means “the capability for continued controlled flight and landing at a suitable airport, 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.”³

The second term, “extremely improbable,” means that the frequency has to be no greater than once in a billion flight hours.⁵ Since the total number of hours of American certified airliners is less than one billion flight hours, continuous smoke in the cockpit should not have happened once. Any condition that would “prevent continued safe flight and landing” is called a “catastrophic” condition.⁴ According to the FAA, this is not acceptable: Catastrophic failure conditions must be shown to be extremely improbable.⁵ Translated, this means that if it is possible that

* The subchapter refers to aircraft.

continuous smoke in the cockpit might exist, to become certified, the manufacturer of the airliner has to show that failure to enable pilots to see will not happen more frequently than once in a billion flight hours.

Again, assuming that the FAA is correct about three fatal accidents citing smoke, the FAA makes its assessments from the “probable cause.” Making decisions about the threat of smoke requires more than a review of “probable cause.” This follows because many factual presentations show that “but for” the smoke, one could reasonably conclude that the aircraft would have landed safely.

There are numerous systems and procedures in place to both prevent and mitigate smoke in the cockpit.

Today’s passenger-carrying aircraft are designed with ventilation systems capable of efficiently evacuating smoke from the cockpit. Trained flight crews are well versed in handling incidents of smoke in the cockpit.

We take no issue with these statements but they don’t go far enough. They are only valid for finite amounts of smoke. The FAA’s statements fail to address continuous or unstoppable blinding smoke in the cockpit. The fact that the FAA does not require a manufacturer to test for unstoppable smoke in the cockpit tends to indicate that the airliner manufacturers cannot offer continuous pilot vision when the smoke is unstoppable. This assertion is ratified further by the fact that the FAA directs pilots to land as soon as possible when that is the case.

All cockpits have emergency equipment that includes quick-don oxygen masks for breathing, smoke goggles that allow pilots to see the instruments, and fire extinguishers.

We know of no goggles that can see through dense, blinding smoke. Furthermore, as concerns fire extinguishers, it is common knowledge that most fires are not accessible and of unknown origin.

The FAA does not discourage operators from installing systems to aid pilots’ vision in cases of smoke in the cockpit.

This is not a matter of “not discourage[ing] operators,” this is a matter of regulatory requirements to enable pilots to see to control and land when there is dense blinding smoke in the cockpit.

We have certified and approved this equipment for optional installation on over 100 aircraft models. The first such approval, for the Emergency Vision Assurance System (EVAS) was issued to Vision Safe, Inc., in 1990. It is approved for installation on over 100 aircraft models. However, EVAS, or any similar system, is not required for safe operation of an airplane.

This last sentence begs the question: airlines are safe but can they be made safer? We think so and the FAA thinks so or it would not include emergency vision technology on its aircraft. It is simply untrue to say: “EVAS, or any similar system, is not required for safe operation of an airplane.” FAA regulations require equipment and procedures to deal with “accumulation of hazardous

quantities of smoke in the cockpit.” Unstoppable, dense, blinding smoke clearly constitutes “hazardous quantities of smoke.” Equipment, systems and procedures to deal with this recurring unsafe condition is absolutely required by FAA regulations for the “safe operation of an airplane.”

Therefore, the installation of EVAS, or any similar system, remains an equipment option, available to operators based on their assessed needs.

[See comment above](#)

In addition, the language suggests that the FAA deny non-compliant foreign-registered aircraft permission to land at U.S. airports.

Imposing a requirement on foreign carriers suggests that the FAA intends to enforce the requirement through surveillance.

No. We suggest nothing more onerous than the existing rules under 14 CFR §129, regulations imposed on the operations of foreign carriers. Section 129 imposes many items, from a complete smoking ban on arriving foreign aircraft to security matters. We see the need for pilots to have continuous vision as a safety and security issue easily inferred in existing regulations.

This would open up our carriers to retaliation from other countries to enforce requirements of their choosing on our operators. Language such as this must be reserved for true cases of adverse safety, with supporting data indicating U.S. citizens' lives are in jeopardy. There is no such data for this proposal.

[As previously mentioned, there is adequate data to support that U.S. citizens' lives are in jeopardy.](#)

This proposed language could have the effect of restricting the FAA's ability to take appropriate safety actions when necessary. Title 14 U.S. Code of Federal Regulations, Part 39, Airworthiness Directives, provides the legal framework for the FAA to issue corrective actions for unsafe conditions found in aviation-related products. By defining the term “unsafe condition,” it is likely a condition could arise that poses a safety risk, but somehow that condition does not fit the proposed definition. The FAA must preserve the latitude to define an unsafe condition on a case-by-case basis, using all pertinent available data.

[The collective wisdom of the aviation branches of over 25 European countries have collectively defined what an unsafe condition is.⁶ We see no reason or sensible justification for not having a definition of this profoundly important safety matter. \(To read the European definition, see \[http://www.easa.eu.int/ws_prod/g/doc/Agency_Mesures/Certification_Spec/decision_ED_2003_01_RM.pdf\]\(http://www.easa.eu.int/ws_prod/g/doc/Agency_Mesures/Certification_Spec/decision_ED_2003_01_RM.pdf\) Beginning at page 18.\)](#)

[Without a definition, the phrase “unsafe condition” can have an infinite number of definitions. Without a definition, it can stand for whatever suits the FAA's purpose. This brings to mind Aristotle, who wrote, “\[i\]f . . . a word has an infinite](#)

number of meanings, obviously reasoning would be impossible; for not to have one meaning is to have no meaning, and if words have no meaning our reasoning with one another . . . has been annihilated.”⁷

There is no data, in-service or otherwise, to warrant defining “continuous unstoppable opaque smoke” as an unsafe condition. It is an abnormal condition. The presence of smoke in a cockpit is a side-effect of an underlying defect in a component or system and can be mitigated by the crew, using aircraft systems and equipment and by employing effective crew procedures.

Many unsafe conditions are abnormal. We have presented much data and in-service reports that clearly show this is in numerous cases a catastrophic condition, let alone unsafe. For the FAA to argue that dense blinding (opaque) smoke in the cockpit should not be labeled an unsafe condition is quite frankly ludicrous.

It is impossible for the FAA to say that “continuous unstoppable opaque smoke” is not an unsafe condition since “unsafe condition” has not been defined. But put against the European definition, there is no question but that it is.

We agree that smoke in the cockpit is a side effect of an underlying defect. But so is a forced water landing. Yet the FAA has decided to offer a last-chance solution to passengers and crew in that event. We are perplexed why it resists offering a similar last-chance solution for blinding unstoppable smoke in the cockpit, particularly since it has a solution to the problem on its own aircraft.

Creating a two-tier safety environment is not the American way nor is it consistent with the Congressional charter for the Department of Transportation and the Federal Aviation Administration.

Endnotes

¹ U.S. National Transportation Safety Board, "Safety Recommendation," A-07-49-A-07-50 (Sept. 4, 2007) available at http://www.nts.gov/Recs/letters/2007/A07_49_50.pdf

² This is a small subset of a much larger collection of accidents in which smoke was a cause or a factor of the accident. To see the complete list, please see <http://www.smokeinthecockpit.com/references/List-of-Some-Smoke-Related-Accidents.pdf>

Switzerland

In 1970, a bomb exploded on Swissair flight 330. "[T]he aircraft was flyable but ultimately crashed because the pilots couldn't see their flight instruments, which are critical to maintaining safe flight."²

Barbados

In 1976, a Cubana DC-8 experienced a bomb on board the aircraft. After the explosion, the aircraft remained flyable. The pilot attempted to make an emergency landing. "Finally it became impossible to see the flight instruments because of the smoke." As a result, the Commission of Enquiry recommended: "The criteria for the certification of large Commercial aircraft should include requirement for a positive means of smoke removal, particularly from the cockpit area."²

United Arab Emirates

In September 1983 The British Civil Aviation authorities held that the cause of a Gulf Air Boeing 737 crash was due to possible sabotage. The cockpit voice recorder indicated that the "pilots unable to see instruments due [to] smoke."²

South Africa

In 1987, a Boeing 747 combi-cargo aircraft was lost at sea. The problem began when the Captain radioed to Mauritius air traffic control. In the crews' conversation with air traffic control, the conversation was reminiscent of many other smoke-related transmissions:

Pilot: Er, good morning, we have, er, a smoke problem and we are doing an emergency descent to level one five, er, one four zero.

Mauritius ATC: Confirm you wish to descend to flight level one four zero?

Pilot: Ja, we have already commenced, er, due to a smoke problem in the aeroplane.²

Although the investigative report considered a breakup in flight or carbon monoxide poison, it also considered "disorientation consequent of reduced cockpit visibility in smoke, or pilot distraction."

Norway

In late 1989, an SAS DC-9 experienced heavy smoke while at altitude. The pilots made an emergency descent. On final approach, the smoke intensified to the point that the "smoke intensity on flight deck seriously impaired the pilot's ability to see the flight instrumentation."²

Germany

In 1993, Swissair 551 reported smoke in the cockpit due to an electrical fire. The captain elected to return to his departing airport. Within four minutes, he declared an emergency and told his co-pilot that he could no longer see his instruments. The pilots miraculously got the aircraft on the runway but on rollout were unable to see outside. The German FUS recommended use of an "inflatable view channel between the crew, their instruments and the cockpit windows."² In other words, the German equivalent of the NTSB recommended the same technology that the Secretary of Transportation and the FAA have on their aircraft.

The German safety investigators recommended that airlines invest in emergency vision technology. Swissair seriously considered solving this critical safety issue.² However, it appears that for economic reasons, it chose not to do so.² Unmotivated to invest in safety equipment, the cost of which would have been approximately \$35,000 per aircraft, Swissair invested a few years later in an in-flight entertainment network (IFEN), at a cost of \$3.4 million per aircraft,² one of which became implicated in the crash of Swissair 111.²

Canada

The 1998 crash of Swissair 111 began with a hurried transmission from the cockpit reporting, "smoke in the cockpit." After a thorough investigation, one of the important observations the Canadian Transportation Safety Board made was that "... the end of the checklist de-emphasizes the importance of anticipating that any *unknown smoke condition in an aircraft can worsen rapidly*."² (Emphasis added.)

³ U.S. Department of Transportation. Federal Aviation Administration. Advisory Circular 25-1309-1A, (6/21/88) p. [to come]

⁴ U.S. Department of Transportation. Federal Aviation Administration. Advisory Circular 25-1309-1A, (6/21/88) p. 5

⁵ U.S. Department of Transportation. Federal Aviation Administration. Advisory Circular 25-1309-1A, (6/21/88) p. 7, 10.

⁶ The FAA defined "unsafe condition" in Congressional testimony as "any condition that would jeopardize the continued safe flight and landing of the aircraft." (Testimony of Thomas McSweeney, FAA Director of Certification, before the United States Senate Committee on Commerce, Science & Transportation, Aviation Subcommittee, Nov. 8, 1993.)

The European Aviation Safety Agency (EASA) has a more expansive definition:

An unsafe condition exists if there is factual evidence (from service experience, analysis or tests) that :

- (a) An event may occur that would result in fatalities, usually with the loss of the aircraft, or reduce the capability of the aircraft or the ability of the crew to cope with adverse operating conditions to the extent that there would be :
 - (i) A large reduction in safety margins or functional capabilities, or
 - (ii) Physical distress or excessive workload such that the flight crew cannot be relied upon to perform their tasks accurately or completely, or
 - (iii) Serious or fatal injury to one or more occupants. . . .

Note 4 : There may be cases where events can be considered as an unsafe condition if they occur too frequently (significantly beyond the applicable safety objectives) and could eventually lead to consequences listed in (a) in specific operating environments. Although having less severe immediate consequences than those listed in (a), the referenced events may reduce the capability of the aircraft or the ability of the crew to cope with adverse operating conditions to the extent that there would be, for example, a significant reduction in safety margins or functional capabilities, a significant increase in crew workload, or in conditions impairing crew efficiency, or discomfort to occupants, possibly including injuries. (ACJ 39.5 "Definition of an Unsafe Condition." RST 02/2, doc 17d)

⁷ Aristotle, *Metaphysica* Book IV, Chapter 4.