

# The FAA requirement for pilots to see so they can control and land the airplane when smoke in the cockpit cannot be stopped

## Background

The Federal Aviation Administration (FAA) has a regulation that, if properly implemented, would mandate an aircraft manufacturer to demonstrate that the pilot can see to land while maintaining visual contact with his vital flight instruments when the cockpit is continuously filled with smoke. As currently enforced, however, the FAA only requires the aircraft manufacturer to show that temporary smoke can be evacuated within three minutes after the smoke source is turned off so they can discern their instruments. If the smoke cannot be stopped, the FAA directs the pilot to land at the nearest suitable airport or landing site. At issue is how are pilots are supposed to land if the smoke prevents seeing out the window, viewing their vital instruments, or performing FAA required tasks such as working through emergency check lists or reading approach plates.

The Federal Aviation Regulation states:

If accumulation of hazardous quantities of smoke in the cockpit area is reasonably probable, smoke evacuation must be readily accomplished, starting with full pressurization and without depressurizing beyond safe limits.<sup>1</sup>

The purpose of the regulation, in the words of a former FAA administrator Thomas Richards, is to provide “an adequate view of the instruments and the outside world.”<sup>2</sup> Yet, in spite of Richards’ interpretation, former Deputy FAA Administrator Tony Broderick said that the FAA has “never applied the regulation to require that the pilots be able to see in conditions of dense smoke. . . .”<sup>3</sup>

The National Transportation Safety Board (NTSB) has recommended that a pilot should be able to see out of a smoke filled cockpit.<sup>4</sup> The NTSB acknowledged the “smoke in the cockpit” problem after investigating the May 1996 fatal crash of ValuJet 592 in the Florida Everglades. The NTSB concluded in its final report of that accident that “emergency cockpit vision devices might have potential safety benefits in some circumstances.” The Board formally recommended (A-97-61) that the FAA evaluate “the cockpit emergency vision technology and take action as appropriate.”<sup>5</sup>

The recent “smoke in the cockpit” call from Swissair 111 was reminiscent of a 1970 Swissair accident in which the plane crashed because of smoke in the cockpit. The FAA has since acknowledged that *continuous* smoke in the cockpit was “reasonably probable.”<sup>6</sup> However, it did not and does not require the manufacturers to demonstrate the ability for pilots to see to safely control and land the airplane at a suitable airport or landing site when the smoke cannot be stopped.<sup>7</sup>

It is time for the FAA to enforce the existing safety regulation so that pilots and the flying public have assurances that pilots in smoke-filled cockpits can continue to view their vital flight instruments and see out of the window in order to land in the presences of smoke, regardless of whether or not it is continuous.

An analysis of the smoke evacuation regulation

In 1956, the Airline Pilots Association (ALPA) requested that the Civil Aeronautics Board address the issue of “heavy dense smoke” in the cockpit.<sup>8</sup> The request led to the FAA adopting its current regulation. The regulation has three parts:

- (1) the presence of the smoke must be “reasonably probable;”
- (2) smoke evacuation must be “readily accomplished;” and
- (3) the demonstration must start “with full pressurization and without depressurization beyond safe limits.”

As an aid to both the interpretation of and compliance with the regulation, the FAA wrote an advisory circular<sup>9</sup> in July 1986 to accompany this specific regulation.<sup>10</sup>

*Reasonably Probable*

The first requirement of the regulation is that the presence of smoke be “reasonable probable,” a condition the advisory circular acknowledged. It found several “reasonably probable” sources of smoke including “fires caused by cigarettes, incendiary or explosive devices, cargo fires, and failures of electrical and pneumatic equipment. Fluid leaks or spills, e.g., hydraulic, glycol, etc., in combination with heat or ignition sources may also produce hazardous quantities of smoke.”<sup>11</sup>

Not only did the advisory circular find that smoke was “reasonably probable,” it stated that “[i]ncidents of fire or smoke that cannot be extinguished continue to occur. Smoke and fire procedures should, therefore, be formulated considering that the fire or smoke exposure should be continuous.” (Emphasis added.)<sup>12</sup>

As a testimony to this 1986 edition of the advisory circular, eight years of recent service difficulty reports indicate that fire and smoke-related incidents continue on an average of 10 per month. (See Table 1 below.)

**Table 1**  
**Unscheduled Landings Due to Smoke, Fire, etc. March 1990-March 1998**

<b>Nature of Event</b>	<b>Boeing</b>	<b>McDonnell</b>	<b>Lockheed</b>	<b>Airbus</b>	<b>Total</b>
Flame, Visible Fire	19	13	3	2	37
Smoke, Fumes, Odor	462	391	41	77	971
<b>Total</b>	<b>481</b>	<b>404</b>	<b>44</b>	<b>79</b>	<b>1,008</b>

Source: *Service Difficulty Reports, Aviation DataSource, Inc.*

*Readily Accomplished*

The second phase of the smoke evacuation regulation states that the evacuation of the smoke must be “readily accomplished.” These everyday words should require no further explanation under the plain meaning doctrine of statutory construction.<sup>13</sup> The question, then is whether the advisory circular’s requirement fit, the definition of “readily accomplished.”

Former FAA Administrator Thomas C. Richards stated, “[t]he approach envisioned by the regulations is that there be a means or procedure to evacuate smoke that may be present in the cockpit, thereby providing an adequate view of the instruments and the outside world.”<sup>14</sup> The issue is whether the FAA is properly enforcing the regulation by requiring tests that use only a temporary source of smoke as opposed to a continuous source, when the advisory circular states that continuous smoke is reasonably probable.

There can be no debate that the FAA wanted pilots to be able to land because the July 1986 advisory circular said that the Airplane Flight Manual (AFM) should instruct the pilots “to immediately proceed to the nearest suitable airport when fire or smoke is detected.”<sup>15</sup>

But in spite of the clarification that smoke in the cockpit would most likely be continuous, the Advisory Circular did not require testing with continuous smoke. Instead, test procedures for smoke evacuation provided that the smoke be turned off once the cockpit was filled.

When the cockpit instruments are obscured (standard dial indicator numbers or letters become indiscernible), smoke generation should be terminated, and the appropriate AFM [airplane flight manual] fire and smoke procedures should be initiated. The smoke should be reduced within three minutes such that any residual smoke (haze) does not distract the flight crew nor interfere with operations under Instrument Flight Rules (IFR) or Visual Flight Rules (VFR).<sup>16</sup> (Emphasis added.)

By this wording, the July 1986 advisory circular exempted the aircraft manufacturer from demonstrating that the crew would be able to fly and land under the very circumstances the advisory circular said were most likely to lead to an unsafe condition, i.e., smoke from a continuous source.

Although the FAA attempted to address the loss of pilot vision by requiring the one-time reduction of a small amount of temporary smoke, it has never mandated any means of ensuring pilot vision in the presences of continuous smoke. Therefore, one could reasonably discern that the elimination of continuous smoke cannot be “readily accomplished.”

Although the FAA has steadfastly refused to enforce its regulations with respect to ensuring pilot vision in a smoke filled cockpit, the FAA has taken other measures to deal with the consequences of continuous smoke in the cockpit. For example, in August 1991, the FAA reported that an amendment to 14 C.F.R. § 25.1439, “Protective Breathing Equipment,” was in the process of being drafted. The purpose of the amendment was to require protective breathing equipment (PBE) for each crew member of the flight deck. According to the FAA, “[t]his proposal is necessary because it is likely that any Part 25 type design airplane will experience smoke in the cockpit from sources not effectively dealt with by emergency smoke clearance procedures (e.g., electrical smoke).”<sup>17</sup> As the Protective Breathing Equipment regulation is currently written, it does not require PBE for aircraft with a Class D cargo hold, such as the one flown by ValuJet 592, because Class D cargo holds are defined as cargo holds from which fire and smoke cannot escape.

No one can doubt the importance of providing the flight crew with the ability to breath in the presence of continuous smoke. It should be equally apparent that the ability

to breath without the ability to see is meaningless.

Faced with the FAA's inaction, Congress began its own inquiries into the Agency's position on loss of pilot vision. In Senate Report 102-148 on the Department of Transportation and Related Agencies Appropriations Act for FY 1992, the FAA was asked to review its regulations and certification requirements to determine what actions should be taken to ensure "pilots' critical vision needs are not obscured."<sup>18</sup>

Congress's request was reasonable. After all, the FAA Administrator is required to "exercise and perform his powers and duties . . . in such a manner as will best tend to reduce or eliminate the *possibility* of, or *recurrence* of, accidents in air transportation, . . ."<sup>19</sup> More specifically, the FAA is required to certify that, for an aircraft, "no feature or characteristic makes it unsafe . . ."<sup>20</sup> (Emphasis added.) When an unsafe condition exists, the FAA Administrator is required to issue an "airworthiness directive," and "[n]o person may operate a product to which an airworthiness directive applies, except in accordance with the requirements of that airworthiness directive."<sup>21</sup>

In May 1992, the FAA submitted its report to the Senate Subcommittee on Transportation. The report concluded:

No airplanes certificated since the [July 1986 advisory circular] was published have been lost due to the inability of the flightcrew to see the instruments or view the outside world through the windshield. We see no indication that such an event can reasonably be expected to occur. . . .<sup>22</sup>

Ironically, two months later, FAA staff started to address the problem of loss of pilot vision during incidents involving continuous smoke in a draft revision to the July 1986 Advisory Circular.<sup>23</sup> Significantly, the 1992 *draft* incorporated the sections of advisory circular 25-9 regarding reasonably probable sources of smoke, and again, emphasized that since the 1986 edition of the Advisory Circular, "[i]ncidents of fire or smoke that cannot be extinguished continue to occur."<sup>24</sup> Of more importance, the Advisory Circular added the requirement to generate continuous smoke:

To demonstrate protection from smoke generated by a continuous source in the cockpit, smoke should be generated continuously. The crew should don protective breathing equipment and initiate smoke evacuation procedures and/or activate smoke displacement devices, if needed, as soon as smoke becomes evidence. The ability of the crew to safely operate the airplane should not be impaired by loss of vision due to smoke from a continuous source in or contiguous with the cockpit.<sup>25</sup>

Clearly, the FAA staff was attempting to take stronger measures to address the problem of loss of pilot vision at the very same time the FAA hierarchy was attempting to convince Congress that no such problem existed.

Apparently inconvenienced by the FAA's May 1992 report, Congress directed the FAA to study and report to it on the effects of continuous smoke in the cockpit on pilot vision.<sup>26</sup> The FAA also failed to convince the ALPA. In December 1992, the Chairman of the ALPA Accident Survival Committee, Capt. Ricky R. Davidson, submitted comments endorsing the proposed changes in Advisory Circular 25-9A to test for continuous smoke.

Capt. Davidson stressed ALPA's concern that the flight crew be able to "safely land the aircraft."<sup>27</sup>

In October 1993, the FAA made its report to Congress under Pub. L. 102-581.<sup>28</sup> The FAA concluded that there was no "indication that existing regulations and guidance have resulted in an unsafe condition."<sup>29</sup> The report specifically criticized the Emergency Vision Assurance System created by VisionSafe Corporation stating, "there is no evidence that the device would have been beneficial in preventing any of the accidents and incidents studied."<sup>30</sup> Ironically, this report was issued at the same time the FAA staff, working on Advisory Circular 25-9A, maintained its position that incidents involving fire or smoke that could not be extinguished continued to occur.

Curiously, when the January 1994 revision to the July 1986 advisory circular emerged in final form, in January 1994, the FAA staff position was deleted. Instead, the following language appeared:

Protection against continuously generated smoke in the cockpit, although not specifically required by the regulations, is provided by present smoke evacuation procedures. Present smoke evacuation testing demonstrates the ability of the smoke evacuation system to handle smoke emanating from reasonably probable continuous smoke sources.<sup>31</sup>

Also gone from the Advisory Circular was the staff's position that testing for evacuation of continuous smoke should ensure that pilot vision was not impaired. Instead, the final version of the Advisory Circular provides:

Although not mandatory, if the applicant wishes to demonstrate protection from smoke generated by a continuous source in the cockpit, smoke should be generated continuously. The crew should don protective breathing equipment and initiate smoke evacuation procedures as soon as smoke becomes evidence and, activate any *optional* vision enhancement devices, if approved.<sup>32</sup> (Emphasis in original).

The historical FAA position

The historical Federal Aviation Administration position has been that there is virtually no proof that accidents have been caused by smoke in the cockpit. If there have been any accidents, they have been so few as to not justify the added expense. As former Deputy Administration (Certification & Regulation) Broderick said:

The only airplane I know of . . . is an airplane accident that occurred because of smoke in the cockpit, and resulted in any kind of fatalities, is the freighter accident in Boston in 1974. . . .

The measures that are used every day in the United States are quite clearly able to cope with the hundreds of in flight fires that occur every year. . . . Nineteen years ago we had one accident in a freighter.<sup>33</sup>

Broderick made this statement prior to the ValuJet 592 accident. In that accident, the pilots' conversation indicated they were experiencing major electrical failures. The pilots asked for an immediate return to Miami. When asked why, the copilot radioed, "smoke in

the cockpit.” While the final NTSB report attributed the probable cause to oxygen canisters, there are other facts that tend to indicate that the aircraft was flying around for a longer period looking for a place to land. Even the NTSB recognized that “emergency cockpit vision devices might have potential safety benefits in some circumstances.”

The statement that Broderick made regarding only one accident, however, is not supported by the evidence. Broderick’s argument hangs on the assertion that some of the cases were not air carriers subject to U.S. regulations. But that misses the point: the regulation addresses the aircraft manufacturer not airlines. Boeing, McDonnell Douglas, and Lockheed aircraft had to pass the smoke evacuation regulation regardless of which airline—U.S. or foreign—would ultimately acquire it.

The FAA announced in late September 1998 that it was taking a fresh look at the “aging aircraft” problem. Indeed, Deputy Administrator Tom McSweeney, who holds Tony Broderick’s former position, referring to the smoke evacuation test described in the 1994 revision of advisory circular 25-9A, said the FAA was taking another look at it.

The test is designed to distinguish pass and fail very accurately. . . .  
[T]hey are required to let the entire cockpit fill up with smoke. They are required to let it fill up to the point you can’t see your hand in front of your face. Then they must be able to evacuate the smoke. . . .

We realize that that is not what pilots are going to do in service. We believe in letting that smoke build up there is a lot of benefit that’s not really a part of that test that you get in real life and that is when you get the first sign of smoke you start evacuating. But do we stop there, no, because we are continuing to look at exactly that question: Should we have a different test for continuous smoke. At this point we have not concluded that we should but we are still looking.

The question is what has changed since the FAA last responded to the NTSB’s recommendation on continuous smoke in the cockpit. At that time, the FAA said that the solutions were “optimized.” It said: “the industry design effort” was “already optimize[d] for the use of fire extinguishing, cabin pressurization, air conditioning, and ventilation systems to extinguish or control fires and/or smoke.”<sup>34</sup>

The answer is that nothing has changed except the addition of the FAA certified smoke displacement technology known as Emergency Vision Assurance System (EVAS). This technology has been fully tested, evaluated, and certified by the Federal Aviation Administration. To become certified, it has to be not only safe but effective. This means that it meets its intended function which is to provide for the pilot the ability to see well enough to fly and land the plane in the presence of continuous smoke. The equipment has been installed on military and commercial aircraft. Indeed, hundreds have been ordered in response to the Swissair 111 cry of “smoke in the cockpit.”

The only question now is whether or not the FAA will enforce the smoke evacuation regulation so that the flying public will have the same assurance that thousands of employees flying in business jets have. And that is that the pilot of the airplane will be able to see to safely control and land the airplane in the event that the cockpit fills with smoke from a continuous source. The FAA makes it optional; we believe it should be mandatory.

## Notes

<sup>1</sup>14 CFR 25.831 (d)

<sup>2</sup>Richards to Werjefelt (Jan. 14, 1993).

<sup>3</sup>Tony Broderick, statement made to Bertil Werjefelt (Jan. 26, 1993).

<sup>4</sup>On October 31, 1983, the NTSB recommended that the FAA “evaluate change as necessary the procedures contained in the FAA-approved airplane flight manuals (AFM) of transport category airplanes relating to the control and removal of smoke to assure that these procedures address a continuing smoke source. . . .”

<sup>5</sup>U.S. National Transportation Safety Board. “In-flight Fire and Impact with Terrain Valujet Airlines Flight 592 DC-9-32, N904VJ Everglades, Near Miami, Florida May 11, 1996.” Final Report. (PB97-910406. NTSB/AAR-97/06. DCA96MA054 (Aug. 19, 1997): 138

<sup>6</sup>U.S. Department of Transportation. Federal Aviation Administration. Advisory Circular 25-9, “Smoke Detection, Penetration, and Evacuation Tests and Related Flight Manual Emergency Procedures,” (July 29, 1986), hereinafter Advisory Circular 29-5 (July 1986).

<sup>7</sup>“Suitable airport” is a word of art which has a different meaning than “adequate airport.”

<sup>8</sup>U.S. Civil Aeronautics Board. “Proposed Agenda for the 1956 Annual Airworthiness Review.” Civil Air Regulation Draft Release No. 56-9. (April 16, 1956).

<sup>9</sup>“Certain requirements . . . must be complied with in a manner acceptable to the Administrator. FAA Advisory Circulars contain standards and procedures that are acceptable to the Administrator for compliance. . . . Some of these advisory circulars are referenced in specific sections of this part. The standards and procedures in them, or other standards and procedures approved by the Administrator, may be used to comply with those sections.” 14 CFR § 139.5

The Federal Courts have also interpreted the Advisory Circulars (AC):

“The . . . Advisory Circulars are evidence of the standard of care among all pilots, [citations omitted], and it is assumed that all pilots have read and know their provisions. [Citations omitted.]

In re *N-500L Cases*. 691 F.2d 15 (1st Cir.) at 27.

In another appellate decision, the Court wrote:

“The relevance of the [Advisory Circular] to the (issue) of the defendant's negligence . . . is manifest. Evidence of custom within a particular industry, group, or organization is admissible as bearing on the standard of care in determining negligence. Compliance or noncompliance with such custom, though not conclusive on the issue of negligence, is one of the factors the trier of fact may consider in applying the standard of care.”

In re *Air Crash Disaster at John F. Kennedy International Airport on June 24, 1975*. 635 F.2d 67 (2nd Cir.)

<sup>10</sup>Advisory Circular 29-5 (July 1986).

<sup>11</sup>*Id.* at p. 2.

<sup>12</sup>Advisory Circular 29-5 (July 1986): Par. 4 (e) (2).

<sup>13</sup>*Readily* means “1. in a prompt, timely manner; promptly,” and *accomplished* means “1. to succeed in doing; bring to pass 2. To reach the end of; complete.” American Heritage Dictionary (Electronic Edition.)

<sup>14</sup>Richards to Werjefelt (Jan. 14, 1993).

<sup>15</sup>*Id.* at p. 4

<sup>16</sup>*Id.* at p. 12

<sup>17</sup>“Transport Airplane Directorate Designee Newsletter,” (Aug. 1, 1991): 47.

<sup>18</sup>U.S. Department of Transportation. Federal Aviation Administration. “Report to Congress: Safety Impact of In-Flight Cockpit Smoke Emergencies.” (May 15, 1992).

<sup>19</sup>Federal Aviation Act of 1958, as amended, Title VI, Section 601(b).

<sup>20</sup>14 C.F.R. § 21.21(b)(2).

<sup>21</sup>14 C.F.R. §§ 39.1, 39.3.

<sup>22</sup>*Id.* at p. 3

<sup>23</sup>Advisory Circular 25-9A, “Smoke Detection, Penetration and Evacuation Tests and Related Flight Manual Emergency Procedures,” (July 14, 1992) Exhibit 36

<sup>24</sup>*Id.* at p. 6

<sup>25</sup>*Id.* at pp. 17-18

<sup>26</sup>See, Airport and Airway Safety, Capacity, Noise Improvement, and Intermodal Transportation Act of 1992, Pub. L. 102-581, Sec. 207.

<sup>27</sup>Davidson to Federal Aviation Administration (ANM-110) In re: “Draft Advisory Circular (AC) 25-9A.” (Dec. 11, 1992).

<sup>28</sup>U.S. Department of Transportation. Federal Aviation Administration. “Report to Congress: Smoke in the Cockpit of Transport Category Airplanes.” (October 1993).

<sup>29</sup>*Id.* at p. 1

<sup>30</sup>(*Id.*)

<sup>31</sup>(See, p. 3)

<sup>32</sup>*Id.* at p. 20,

<sup>33</sup>Tony Broderick, statement made to Bertil Werjefelt (Jan. 26, 1993).

<sup>34</sup>FAA date of response 1/27/84.