



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

# Advisory Circular

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**Subject:** FLIGHTDECK PROTECTION (SMOKE AND FUMES)      **Date:** 10/24/08      **AC No:** 25.795-3  
**Initiated By:** ANM-100

**1. PURPOSE.** This advisory circular (AC) describes an acceptable means of showing compliance with the requirements of Title 14, Code of Federal Regulations (14 CFR), part 25, § 25.795(b)(1), “Flight deck protection.” This section requires that an airplane be designed to limit the entry of smoke, fumes, and noxious gases into the flightdeck in the event of detonation of an explosive or incendiary device on the airplane. The means of compliance described in this document provides guidance to supplement the engineering and operational judgment that must form the basis of any compliance findings relative to penetration into the flightdeck of smoke, fumes, and noxious gases generated by explosions or fires elsewhere on the airplane.

## **2. APPLICABILITY.**

**a.** The guidance provided in this document is directed to manufacturers and modifiers of large passenger transport airplanes and repair facilities for such airplanes.

**b.** The material in this AC is neither mandatory nor regulatory in nature and does not constitute a regulation. It describes acceptable means, but not the only means, for demonstrating compliance with the applicable regulations. The Federal Aviation Administration (FAA) will consider other methods of demonstrating compliance that an applicant may elect to present. Furthermore, if we become aware of circumstances that convince us that following this AC would not result in compliance with the applicable regulations, we will not be bound by the terms of this AC, and we may require additional substantiation or design changes as a basis for finding compliance.

**c.** The material in this AC does not change, create any additional, authorize changes in, or permit deviations from regulatory requirements.

**3. RELATED SECTIONS OF 14 CFR.** Part 25, §§ 25.795, 25.831, 25.855, and 25.857.

## **4. BACKGROUND.**

**a.** The International Civil Aviation Organization (ICAO) adopted certain Standards and Recommended Practices related to security aspects of airplane design in Amendment 97 to

Annex 8. Included is a requirement that an airplane have means to limit entry of smoke, fumes, and noxious gases into the flightdeck.

**b.** Prior to the promulgation of 14 CFR 25.795, part 25 did not specifically address penetration of smoke into the flightdeck, except smoke from a fire in the cargo compartment. Sections 25.855(h)(2) and 25.857(c)(3) address penetration of smoke from the cargo compartment. Section 25.831(d) addresses clearance of smoke from the flightdeck.

**c.** AC 25-9A provides specific guidelines pertaining to smoke penetration, smoke detection, and smoke clearance. That AC describes the method of testing for smoke detection, penetration, and evacuation, including equipment requirements, test procedures, and pass/fail criteria. The test procedures described in AC 25-9A effectively do not allow for any penetration of smoke into the flightdeck from a cargo compartment. Section 25.795(b)(1) recognizes that some smoke may initially enter the flightdeck after an explosion or fire anywhere else on the airplane and requires that means must be provided to limit such entry. This approach is consistent with smoke test procedures used for electronics and equipment bays.

**d.** A draft of this AC was harmonized with the European Joint Aviation Authorities (JAA). The draft provided a method of compliance that both the FAA and JAA found acceptable. Subsequently, the European Aviation Safety Agency (EASA) was formed as the principal aviation regulatory agency in Europe. The FAA will work with EASA to ensure that this AC is harmonized with ACs referred to in EASA's Certification Specifications.

## **5. DISCUSSION.**

**a.** Section 25.795(b)(1) is intended to protect the flightdeck from excessive penetration of smoke, fumes, and noxious gases generated by an explosive or incendiary device elsewhere on the airplane.

**b.** As noted above, the test procedures in AC 25-9A do not allow for any penetration of smoke from a fire in the cargo compartment into the flightdeck. Section 25.795(b)(1) assumes that smoke, fumes, and noxious gases resulting from the detonation of an explosive or incendiary device may initially enter the flightdeck, until the flightcrew initiates action to prevent further entry of smoke.

**c.** Flightdeck ventilation systems are designed to supply relatively large quantities of air to meet the ventilation and temperature requirements. It has been shown in airplanes that, if the rate of airflow is sufficient, the airflow can prevent smoke and fumes and noxious gases from entering the flightdeck by creating a small differential air pressure between the flightdeck and adjacent compartments.<sup>1</sup> With the flightdeck door closed, a pressure boundary can develop. This pressure boundary drives air from the flightdeck into adjacent compartments through gaps and openings. The velocity of that airflow is related to the size of the gaps and the amount of the pressure differential.

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<sup>1</sup> See Ground Tests of Aircraft Flight Deck Smoke Penetration Resistance Technical Note DOT/FAA/AR-TN03/36.

**d.** The minimum pressure differential needed to prevent entry of smoke is too small to measure accurately with instrumentation. However, covering the flightdeck door opening with a thin sheet of plastic provides a flexible barrier that will noticeably deform when a small pressure differential exists. When the plastic deflects towards the passenger cabin, smoke cannot enter the flightdeck. This approach provides a visual method of demonstrating compliance. A good design practice would minimize possible routes for entry of smoke into the flightdeck. Such routes include electronic equipment cooling systems, door and floor gaps, and clearances between the bulkhead and supporting structures.

**6. ASSUMPTIONS.** The guidance provided in paragraph 7 below, as to demonstration of compliance with § 25.795(b)(1), is based upon the following assumptions:

**a.** The flightdeck door is closed. The flightcrew is expected to ensure that the flightdeck door is closed to block the entry of smoke and to meet security concerns in general.

**b.** The airplane structure and systems are functional after the event. Therefore, no structural or systems damage or reduction in performance need be considered.

**c.** The airplane is operating in any phase of flight. The applicant is to provide protection from excessive penetration of smoke into the flightdeck, regardless of the location and origin of the fire and during any phase of flight. However, there are foreseeable conditions when the airplane may not always be configured to provide the necessary airflow, such as during

- idle descent operations,
- short duration air conditioning “packs off” operations during take-off and initial climb,
- “packs off” operations during a “go-around,” and
- landing procedures requiring a “hold” in the descent phase.

However, the capability should be readily available. From the time the crew initiates the procedures to provide for flightdeck smoke protection, the airplane should be capable of providing the necessary airflow within 20 seconds.

**d.** Other systems, such as the ventilation system settings and distribution configuration, have been considered, so that the design goal of providing protection from penetration of excessive smoke, fumes, and noxious gases into the flightdeck is not compromised by the settings or procedures for these systems.

**e.** The flow behavior of smoke, fumes, and noxious gases is identical to that of visible smoke. The detection and removal of smoke is assumed to equally remove any fumes and noxious gases that are present.

**f.** In the presence of smoke, fumes, or noxious gases, the required airflow to the flightdeck is achieved by using fresh (outside) air.

**7. DEMONSTRATION OF COMPLIANCE.** Applicants may show compliance with the requirements of § 25.795(b)(1) by analysis and/or by testing that demonstrates that a positive pressure differential is attainable between the flightdeck and any adjacent compartments in all certificated configurations (taking into account the circumstances discussed in paragraph 6c). In showing compliance, applicants should consider possible dispatch conditions for the systems used to provide the required airflow.

**a. Analysis.** Analysis may be used to verify that there is a sufficient positive pressure differential between the flightdeck and any adjacent compartment for the required airplane flight conditions. The analysis should take temperature, buoyancy, and altitude effects into account. The applicant should verify that the analysis accurately represents actual flight conditions. Note that pressure differentials too small to measure directly are unlikely to be predicted reliably through analysis.

**b. Testing.**

**(1) Using a polyethylene sheet.** A non-permeable sheet of material, such as polyethylene 0.002-inch thick or greater, may be attached to the top, sides, and bottom of the door opening with the flightdeck door fully opened or removed. A commercial or industrial sheet meeting the above criteria does not require a conformity inspection. The plastic should be sealed, so that no air gaps exist around the entire perimeter of the door opening. Sufficient polyethylene should be used, so that it can deflect at least 6 inches when light pressure is applied. With the airflow settings properly selected, the polyethylene sheet should deflect away from the flightdeck. The center of the sheet should be forced toward the flightdeck past its neutral position and then released. If the sheet again deflects away from the flightdeck past its neutral position within 10 seconds, a sufficient pressure differential has been demonstrated to meet this requirement. All flight conditions, except as noted in paragraph 6c, should be demonstrated.

**(2) Conducting smoke tests using AC 25-9A as a reference.** Prior to generating any smoke, the applicant should select the airflow settings designed to protect the flightdeck from excessive penetration of smoke, fumes, and noxious gases. Wisps of smoke that enter and immediately exit at the occupied compartment boundaries are acceptable, as long as a light haze or stratified haze does not form.

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