Memorandum

U.S. Department
of Transportation
Federal Aviation
Administration
Subject:

INFORMATION: Policy Statement on
Below Deck Class C Cargo Compartment Smoke Penetration

Date:
DRAFT

From:
Manager, Transport Airplane Directorate, Aircraft
Certification Service, ANM-100

Reply to
Attn. of:
ANM-03-112-06

To:
See Distribution

Regulatory
Reference

AC 25-9A, "Smoke Detection, Penetration, and Evacuation Tests and Related Flight Manual Emergency Procedures," 7/29/86.

Summary

The purpose of this memorandum is to clarify Federal Aviation Administration (FAA) certification policy on smoke penetration tests conducted under the provisions of § 25.857. The issue in question is the amount of smoke penetration permitted into the cabin during a below deck Class C cargo compartment smoke test conducted under the provisions of § 25.857. The material presented below is intended to provide clarification to the test criteria presented as a means of compliance in Advisory Circular (AC) 25-9A, "Smoke Detection, Penetration, and Evacuation Tests and Related Flight Manual Emergency Procedures." As such, it is not intended to replace but to supplement that material.

Current Regulatory and Advisory Material

The following summarizes some essential elements that are necessary to understand the certification policy regarding smoke penetration.

The cabin smoke penetration regulatory standards for transport category airplanes are located in § 25.857, which states that for Class C cargo compartments, "*there are means to exclude hazardous quantities of smoke, flames, or extinguishing agent,* from the occupied area of the airplane (Class B and E requirements are similar). The FAA has never quantified the definition of "*hazardous quantities of smoke, flames, or extinguishing agent.*" It is beyond the scope of this memorandum to provide a quantified definition of the "*hazardous quantities of smoke, flames, or extinguishing agent*" as our office has already recognized the need for an Aviation Rulemaking Advisory Committee (ARAC) activity to accomplish that task. The FAA is in the process of tasking this activity. In addition, the FAA is considering tasking ARAC to review all aspects of fire protection for cargo compartments. This memorandum supplements AC 25-9A by providing further qualitative clarification on the issue of smoke penetration from lower deck cargo compartments into the cabin.

AC 25-9A, paragraph 11a(2) states that:

*"Except as noted in paragraph 11e(4) below**, any penetration of smoke into occupied compartments** from cargo, storage, or baggage compartments, equipment bays, equipment cooking systems, or other non-continuously occupied areas (e.g., galleys, lavatories, or crew rest areas) **during the tests is unacceptable because the toxicity of the smoke is unpredictable and the smoke exposure might continue or increase to a hazardous level before a landing can be made.** The smoke concentrations and exposure time in an actual fire or smoke situation might be well beyond those demonstrated during the limited duration of the smoke penetration tests. Generally, any smoke penetration during the tests demonstrates that the smoke containment means or control methods are unacceptable."*

AC 25-9A, paragraphs 11e(4) and (4)(i) state that:
*"The FAA observer in the occupied compartment should verify that smoke does not penetrate occupied compartments (An alternative technique for this determination is discussed under item (7) below). **The formation of a light haze indicates that the ventilation requirements** of § 25.831(b) **are not being met.** Except as noted below, smoke should not penetrate occupied compartments.*
*(i) 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**. If this condition (i.e., wisps of smoke at the compartment boundary) occurs, the 15-minute test procedure of paragraph 11e(3) should be followed."*

Relevant past Practice and Policy

While no definition was ever provided for the terms "*hazardous quantities of smoke, flames, or extinguishing agent" in the regulation or the AC,* it is clear that some allowance for penetration of these materials into occupied areas was recognized by the rule. Otherwise the rule would have stated "*no penetration of smoke, flames, or extinguishing agent*" is permitted. While steady state, continuous entry of these materials into an occupied area would remain unacceptable, it is reasonable to expect that a small quantity of smoke may penetrate occupied areas during ventilation system transients or other perturbations in the airflow that may occur. Transient airflow conditions may cause air pressure differences between compartments, before the ventilation and pressurization system is reconfigured. Additional transients occur during changes to system configurations such as pack shut-down, fan shut-down, changes in cabin altitude; transition in bleed source change such as from intermediate stage to high stage bleed air, and cabin pressurization "fly-through" during descent may reduce air conditioning inflow. Similarly, it is reasonable to conclude that a small quantity of smoke that penetrates into an occupied area before the ventilation system were reconfigured in the event of fire detection, would be acceptable under certain conditions. Small quantities or "wisps" of smoke may penetrate the occupied areas as long as the situation represents a dynamic event with dissipation (i.e., are rapidly diluted by the ventilation air) or mobility (i.e., quickly enter and exit the occupied area). In no case, should there be a formation of a light haze indicative of stagnant airflow, as this would indicate a failure of the ventilation system to meet § 25.831(b) requirements. The small quantity of smoke that penetrates must not rise above the armrest height of the seat for passenger airplanes. This height was selected because it is believed to represent the head level of a small child or infant held on the lap of an adult and therefore, it represents a reasonable vertical height limit.

In addition, FAA believes that in keeping with the intent of the regulation, and the FAA's policies on fire safety, the means of compliance demonstration should include a flight test that simulates the emergency procedures likely to occur in the event of a fire during flight (e.g., use of emergency descent, approach, and landing).

The amount of smoke penetration allowed is difficult to quantify and the means of compliance will continue to involve subjective judgements. The relevant regulations and guidance may be the subject of future rulemaking activity.

Effect of Policy

The general policy stated in this document does not constitute a new regulation or create what

the courts refer to as a "binding norm". The office that implements policy should follow this policy when applicable to the specific project. Whenever an applicant's proposed method of compliance is outside this established policy, it must be coordinated with the policy issuing office, e.g., through the issue paper process or equivalent.

Applicants should expect that the certificating officials will consider this information when making findings of compliance relevant to new certificate actions. Also, as with all advisory material, this policy statement identifies one means, but not the only means, of compliance.

Conclusion

The following guidance may be used when demonstrating compliance to § 25.857 and will be added to AC 25-9 in the next revision:

(1) A small quantity of smoke may penetrate into occupied areas during system transients. No sustained smoke penetration beyond system transients is permitted.

(a) The small quantity of smoke must rapidly dissipate (i.e., rapidly diluted by the ventilation air) or quickly enter and exit the occupied area. No buildup of a haze is permitted.

(b) The small quantity of smoke must not rise above the armrest height of the cabin.

(2) The means of compliance demonstration should include a flight test that simulates the emergency procedures likely to occur in the event of a fire during flight (e.g., including use of an emergency descent, approach, and landing.)

If you have further questions, the person on my staff most familiar with this issue is Mr. Steve Happenny ((425) 227-2147).