Continued Fireworthiness of Aircraft Interior Materials

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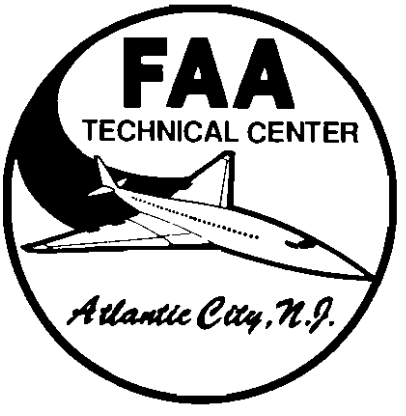
NOTICE



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16. Abstract

Vertical flammability tests specified by the Federal Aviation Administration (FAA) under FAR 25.853 were performed on a variety of interior materials removed from surplus DC-10, B-707, and B-747 aircraft in order to verify their continued fireworthiness. It was determined that the large majority of materials were in conformance with the test requirements. Exceptions were urethane foam ducting insulation and two composite panels due to the flammable nature of their adhesives.

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1. INTRODUCTION.

1.1 PURPOSE.

The purpose of this report is to present the results of flammability tests performed on interior aircraft components removed from surplus aircraft in order to verify continuing fireworthiness.

1.2 BACKGROUND.

The National Transportation Safety Board (NTSB) requested that the Federal Aviation Administration (FAA) conduct research on the effect of in-service wear on the continued fireworthiness of fire-blocking seat materials. This request was based on an incident that occurred in 1993 involving an MD-11 operated by a foreign carrier. One report, "The Effect of Wear on Fire-Blocking Layer Material Effectiveness," documented the erosion of fire-blocking layer effectiveness of the graphitized fabric used in the incident aircraft [1]. A second report describes the findings of a visual inspection of fire-blocking layers in service aircraft and test results on used fire-blocking materials [2]. This report concludes that fire blocking layers employed by U.S. airlines retain their effectiveness after service wear and tear. Generally, U.S. airlines do not use graphitized fabrics as fire-blocking layers. This question of continuing compliance prompted the FAA to investigate the fireworthiness of other aircraft interior materials based on the outcome of the flammability tests performed on the seat cushions removed from the MD-11 aircraft.

2. TEST SAMPLES.

After 1972 and prior to 1988, when the FAA imposed low heat release requirements for large surface area materials, interior materials used in compartments occupied by the crew or passengers were only required to self-extinguish when tested vertically with a Bunsen burner ignition source used in accordance with the applicable portions of Appendix F of Federal Aviation Regulation (FAR) 25.853. Materials were subjected to either a 60-second or 12-second flame and are specified in FAR 25.853 (a) and (b).

A variety of materials were taken from surplus DC-10, B-707, and B-747 aircraft acquired by the Technical Center for testing purposes. Both the DC-10 and the B-747 aircraft were certificated to the vertical Bunsen burner test requirement by special conditions. However, the B-707 aircraft was issued a type certificate in 1958, prior to the imposition of the vertical Bunsen burner test requirement for all interior materials (there are exemptions for small parts). At that time interior aircraft materials such as side and ceiling panels, floors, and upholstery had to be at least flame resistant. Horizontal flammability testing was considered acceptable for demonstrating compliance with Civil Air Regulation (CAR) 4b, the regulatory document in effect at that time. In 1961, the Boeing company adopted an internal requirement that specified that interior aircraft materials be self-extinguishing within 15 seconds when tested vertically. This applied to both commercial and military aircraft. In light of this, a decision was made to test all samples according to FAR 25.853(a) or (b) and not perform any horizontal testing. Three specimens of each of these materials were cut into 3- by 12-inch test samples and tested according to Appendix F of FAR 25.853 a or b. A description of these test samples is given in table 1.

3. FLAMMABILITY TEST RESULTS.

Results of the flammability testing are given in table 2. The data indicates that all materials were self-extinguishing and the majority of test samples were in conformance with the Bunsen burner test requirements and therefore continued to maintain fireworthiness. Only 3 of the 20 materials tested did not meet the test requirements. Materials C and K failed due to flameout times exceeding the 15-second maximum time allowed. Both samples failed due to prolonged burning of the adhesive following removal of the Bunsen burner. In one case, material C, only 1 of the 3 samples tested exceeded the flameout time, but that sample continued to burn for a relatively long time (146 seconds). From table 2, it can also be seen that both samples had burn lengths less than the 6-inch maximum allowed (5.10 and 5.08 inches respectively). Sample T (insulation) was the most flammable of the materials tested and failed both flameout time and burn length requirements. Failure occurred due to the flammable flexible urethane foam core.

4. CONCLUSIONS.

1. All materials were self-extinguishing.

2. The majority of materials were in conformance with the vertical Bunsen burner test requirements and therefore continue to maintain fireworthiness.

3. All thermoformed or thermoplastic materials were in conformance with the vertical Bunsen burner test requirements.

4. Certain adhesives used in the construction of two panels tested were relatively flammable and caused flameout failure of both panels.

5. Flexible urethane foam used for insulation failed both flameout time and burn length requirements by significant margins.

5. REFERENCES.

1. Barrientos, M.J., "The Effect of Wear on Fire-Blocking Layer Material Effectiveness," DOT/FAA/CT-TN94/16, January 1995.

2. Ingerson, D., "A Study of the Continued Fireworthiness of Aircraft Seat Cushion Fire Blocking Layers," DOT/FAA/AR-95/49, unpublished.

TABLE 1. TEST SPECIMENS

Material Code	Description
A	thermoplastic seat component
B	thermoformed part—section of food tray
C	class partition—balsa wood core—adhesive—polymeric material front and back face
D	class partition—honeycomb core
E	ceiling panel—honeycomb core
F	textile covered panel—located at foot of sidewall
G	floor panel—balsa core
H	thermoplastic seat component—section of arm rest
I	thermoplastic—bottom side of seat
J	thermoplastic end bay shroud*
K	cabinet door panel
L	towel disposal cabinet panel
M	insulation batt—polyester film cover—located near window
N	fiberglass batt—polyester film cover—stowage bin panel
O	stowage bin panel
P	fiberglass batt—vinyl cover
Q	thermoplastic seat component
R	stowage bin panel—50 lb capacity
S	window reveal panel—honeycomb core
T	insulation—flexible urethane foam
U	stowage bin panel—honeycomb core
V	ceiling panel—honeycomb core
W	floor panel—balsa wood core—rigid urethane foam backing

*end bay shroud - term used for thermoformed parts on end of aircraft seat.

TABLE 2. VERTICAL FLAMMABILITY TEST RESULTS
(data are averages of three tests)

Material Code	Ignition Time (seconds)	Flameout Time (seconds)	Burn Length (inches)	Flame Time Drippings	Notes
A	12	0	1.41	0	
B	12	0	0.58	0	
C	60	56.3	5.10	0	adhesive appeared to cause excessive flameout time
D	60	0	4.33	0	
E	60	6.27	0		
F	60	0	2.26	0	
G	60	0	0.2	0	
H	12	0	1.97	0	
I	12	0	1.97	0	
J	12	0	0.60	0	
K	60	26.7	5.08	0	adhesive appeared to cause excessive flameout time
L	60	10.5	4.66	0	
M	12	0	0	0	polyester film cover shrunk—fiberglass batt discolored
N	12	1.73	0	0	flameout time noted on one sample due to scrim material
O	60	0	4.89	0	
P	12	3.26	4.47	0	
Q	12	0	1.66	0	
R	60	0	5.39	0	
S	60	0	5.22	0	
T	12	118.7	9.06	0	urethane foam underneath propagated flame
U	60	7.0	3.19	0	
V	60	0	2.97	0	
W	60	0	0.4	0	