United States General Accounting Office

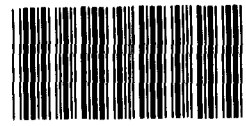
GAO

Report to Congressional Requesters

January 1993

AVIATION SAFETY

Slow Progress in Making Aircraft Cabin Interiors Fireproof



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GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-250375

January 6, 1993

Congressional Requesters

In response to your requests and subsequent agreements with your offices, this report provides information on the Federal Aviation Administration's (FAA) flammability standards for materials used in the cabin interiors of transport airplanes. Specifically, the report examines the aviation industry's efforts to equip the U.S. fleet with cabin interiors that meet the latest flammability standards and the potential costs and safety benefits if FAA were to mandate retrofitting by a specific date. The report makes a recommendation to the Secretary of Transportation aimed at helping FAA to reassess whether to mandate a specific date for all aircraft in the fleet to comply with the latest flammability standards for cabin interiors.

As arranged with your offices, unless you publicly announce its contents earlier, we will make no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to the appropriate congressional committees; the Secretary of Transportation; the Administrator, FAA; and the Director, Office of Management and Budget. We will also make copies available to others on request.

This work was performed under the direction of Kenneth M. Mead, Director, Transportation Issues, who can be reached at (202) 275-1000 if you or your staffs have any questions. Major contributors to this report are listed in appendix II.

J. Dexter Peach
Assistant Comptroller General

List of Requesters

The Honorable James L. Oberstar
Chairman
The Honorable William F. Clinger, Jr.
Ranking Minority Member
Subcommittee on Aviation
Committee on Public Works and Transportation
House of Representatives

The Honorable John D. Dingell
House of Representatives

The Honorable Ernest F. Hollings
Chairman, Committee on Commerce, Science,
and Transportation
United States Senate

The Honorable Wendell H. Ford
Chairman, Subcommittee on Aviation
Committee on Commerce, Science,
and Transportation
United States Senate

Executive Summary

Purpose

Since 1985 about 16 percent of all U.S. transport aircraft accidents have involved fire. About 22 percent of the fatalities in these accidents resulted from the effects of fire and smoke. In 1986 and 1988, the Federal Aviation Administration (FAA) issued regulations to improve the flammability standards for materials used in aircraft cabin interiors. However, several aircraft accidents in the past 2 years have raised concern about the ability of occupants to escape from a post-crash fire. Because of this concern, the Chairman and Ranking Minority Member, Subcommittee on Aviation, House Committee on Public Works and Transportation; the Chairmen, Senate Committee on Commerce, Science, and Transportation and its Subcommittee on Aviation; and Representative John D. Dingell asked GAO to provide information on the (1) proportion of the U.S. aircraft fleet that meets or is expected to meet FAA's flammability standards through 1999, (2) estimated cost if all aircraft had to meet the standards by certain hypothetical dates, and (3) estimated safety benefits of meeting the standards under each hypothetical date.

Background

A major safety concern in an airplane accident is the ability of cabin occupants to survive the fire, smoke, and toxic gases that may result. To increase the likelihood of surviving a post-crash fire, in 1986 and 1988 FAA upgraded its flammability standards for materials used in aircraft cabin interiors. Under the new standards, the materials and coverings of all larger interior surface components, including sidewalls, ceilings, bins and partitions, and galley structures, are required not only to be self-extinguishing but also must limit the amount of heat released and smoke emitted when the components are exposed to fire. FAA fire tests demonstrated that the stricter standards could provide up to 17 seconds additional time for occupants to escape a burning aircraft, allowing more passengers to escape. The stricter flammability standards applied to all aircraft manufactured after August 19, 1990. For aircraft that were in-service on that date, airlines have to comply with the new standards only when they undertake a substantially complete replacement of cabin interior components.

Results in Brief

In establishing the stricter flammability standards, FAA anticipated that almost 85 percent of the fleet would comply by 2000 and indicated that it would consider proposing a mandatory retrofit requirement if all airlines did not meet the standards as anticipated. At the beginning of 1992, about 11 percent of the over 4,200 aircraft in the fleet complied with the standards. Although the number of newly manufactured aircraft meeting

the standards will increase each year, no airline has replaced or plans to completely replace the interior components of aircraft that were in-service on August 19, 1990 (in-service aircraft). As a result, 45 percent of the aircraft fleet is expected to be operating with cabin interiors not meeting the latest flammability standards by the end of the decade. In fact, under the current practice of replacing aircraft, the entire fleet is not expected to comply with the stricter flammability standards until 2018.

The total cost to the airlines to modify aircraft not meeting the standards would be several billion dollars and average over $1 million per aircraft. Although costs can be reliably estimated, more uncertainty exists in reliably estimating the potential lives saved and their value because airline accidents occur infrequently and unpredictably, and no consensus exists on the value of a human life. FAA estimated that 9 to 16 lives could be saved each year if all aircraft met the stricter flammability standards. If the Department of Transportation's (DOT) current value of $1.5 million for a human life were used to extrapolate a value for the potential fatalities avoided, then up to $110 million could potentially be saved by modifying aircraft to meet the standards. However, one or two significant accidents could result in the loss of hundreds of lives and, depending on how high a value was used for a human life, the potential savings could be much higher.

Principal Findings

Airlines Are Not Modifying Aircraft

By the beginning of 1992, about 470 aircraft had been manufactured to comply with the latest flammability standards, representing about 11 percent of more than 4,200 aircraft in the fleet. At that time, no airline had completely replaced interior components of even one in-service aircraft to meet the standards. Moreover, airlines do not plan to modify aircraft to meet the stricter flammability standards. However, the proportion of the fleet that meets the standards is expected to increase each year as new aircraft replace older aircraft not meeting the standards. On the basis of projected aircraft retirements as well as new purchases, an estimated 30 percent of the fleet is expected to meet the flammability standards by the end of 1994, 42 percent by the end of 1996, and 55 percent by the end of 1999.

Almost all aircraft that currently do not meet the flammability standards will undergo some type of routine heavy maintenance inspection by the end of the decade, providing airlines the opportunity to modify cabin interiors. However, airlines infrequently replace entire cabin interiors. Although a portion of the interior components is removed during a heavy maintenance inspection, airline officials told GAO that the components not meeting the standards are usually refurbished and reinstalled, rather than replaced with components that meet the standards. Industry practice is to replace a worn-out component with one that meets the standards if it is necessary to purchase a new component. However, this piecemeal replacement of individual components will likely not significantly reduce the hazards posed by a post-crash fire.

Cost Impact of Modifying Aircraft

GAO estimated that the total cost (in present value) for airlines to replace the cabin interiors for aircraft in the fleet not meeting the standards by the end of 1994 (70 percent of fleet), 1996 (58 percent of fleet), and 1999 (45 percent of fleet) would be $3.8 billion, $3.1 billion, and $2.5 billion, respectively. Total costs are expected to decrease each year because fewer aircraft would require modification as airlines replace more aircraft not meeting the standards with new ones. In addition, the airlines' annual financial burden would be reduced as costs are spread over more years. Under the 1994 date, for example, airline costs would average about $1.3 billion each year. In contrast, airline costs would average about $312 million each year under the 1999 date.

Safety Benefits of Modifying Aircraft

On the basis of FAA's estimate of the potential lives that could be saved each year if all aircraft met the standards and the percentage of the fleet that would meet the standards for the period 1992 through 2018, between 75 and 100 fatalities could be potentially avoided from modifying aircraft. Using DOT's value of $1.5 million for a human life, the present value of the potential fatalities avoided would range from $80 million to $110 million. GAO recognizes, however, that the number and total value of potential lives saved could be higher or lower, depending on the number and severity of accidents during the analysis period and the value placed on a human life.

Recommendation

GAO recommends that the Secretary of Transportation direct the Administrator, FAA, to reassess whether to issue a regulatory requirement mandating a specific date for all aircraft in the fleet to comply with the latest flammability standards for cabin interiors. Such a reassessment

should compare the cost-effectiveness of retrofitting aircraft to meet the standards with other actions that could improve the overall safety of the U.S. aircraft fleet.

Agency Comments

DOT officials reviewed a draft of this report. Their comments have been incorporated as appropriate. FAA's Deputy Director, Aircraft Certification Service, and other DOT officials do not believe that a reassessment of the flammability standards is warranted. FAA officials stated that GAO's findings, as well as an internal FAA cost analysis for refurbishing aircraft cabin interiors, indicate that the costs to retrofit the fleet outweigh the potential safety benefits; therefore, mandating a retrofit requirement would not be cost-effective. GAO believes that cost is an important factor in considering any action to improve safety; however, other factors could have a greater influence on a decision to implement an action. For example, FAA established the current flammability standards for cabin interiors to achieve a safety objective, even though its analysis of estimated costs exceeded the estimated dollar value of benefits. Moreover, in the Notice of Proposed Rulemaking and regulatory evaluation for the current standards, FAA anticipated that about 85 percent of the fleet would meet the standards by 2000 and indicated that it would consider mandating a retrofit requirement if components not meeting the standards remained in service in a significant number of aircraft and a substantial increase in overall safety could be realized. Since 45 percent of the aircraft fleet will likely not meet the flammability standards by the date FAA anticipated and additional benefits will likely be realized the sooner that all aircraft in the fleet comply, GAO believes that a reassessment of the need to mandate a retrofit is warranted.

Contents

Abbreviations

ATA	Air Transport Association
DOT	Department of Transportation
FAA	Federal Aviation Administration
GAO	General Accounting Office

Introduction

The Federal Aviation Act of 1958, as amended, and the Department of Transportation Act, as amended, established the safe travel of U.S. air passengers as a joint responsibility of the Federal Aviation Administration (FAA) and the airlines. A major safety concern is the ability of aircraft cabin occupants to survive post-crash fire, smoke, and toxic gases. Over the years, FAA has focused on ways to provide additional time for passengers trapped in a burning airplane to escape. To increase the likelihood of surviving a post-crash fire, FAA has amended its regulations several times to impose more stringent flammability requirements for aircraft cabin interior materials.

Responsibilities for Aviation Safety

FAA promotes aviation safety by issuing regulations that aircraft manufacturers and airlines must meet to build and operate commercial aircraft. Aircraft manufacturers are responsible for designing safe aircraft, and air carriers are responsible for safely operating and properly maintaining their aircraft according to FAA regulations that set minimum acceptable standards for safety and maintenance. FAA, in turn, monitors the industry's compliance with the regulations.

Within FAA, the Aircraft Certification Service is responsible for regulatory or enforcement action to ensure the continued safety of aircraft. The Certification Service also prescribes standards governing the design, production, and airworthiness of aeronautical products, including cabin interiors, by aircraft manufacturers. Aircraft manufacturers must comply with the standards under the Code of Federal Regulations, title 14, part 25. Under part 25, FAA must certify new aircraft designs as safe before the carriers use them commercially.

FAA's Flight Standards Service is primarily responsible for both certifying an airline's initial operations (assessing an airline's ability to carry out its proposed operations and the airworthiness of the aircraft) and monitoring the operations and maintenance of an airline's fleet. Scheduled commercial airlines operate and maintain their aircraft under the Code of Federal Regulations, title 14, parts 121 and 135. Part 121 regulations generally apply to large passenger and cargo aircraft—those that carry more than 30 passengers or a load greater than 7,500 pounds. Part 135 regulations generally apply to smaller aircraft—those that carry 30 or fewer passengers and a load not exceeding 7,500 pounds.

Aircraft Fire Survivability

Although the accident record of the U.S. airline industry is excellent, accidents that do occur can have severe consequences. Between 1985 and 1991, 32 accidents, or about 16 percent of all transport aircraft accidents, involved fire. About 27 percent of the occupants in such accidents died (637 fatalities), and 22 percent of the fatalities (140) resulted from the effects of fire or smoke. Fire is a major concern because of the large quantities of flammable fuel carried by the aircraft and because of the cabin's design. Once interior materials begin to burn, the fire spreads rapidly throughout the aircraft because of its long, narrow interior design. Conditions within the aircraft degrade rapidly to the point where life cannot be sustained except possibly at locations close to the floor. If the fire grows, a condition called "flashover" is reached, when everything within the cabin is burning and survival is impossible.[1]

Flammability Standards for Materials Used in Aircraft Cabin Interiors

In recent years, FAA has implemented a series of new standards to improve aircraft cabin safety, particularly in the fire safety area. The major improvements are summarized in appendix I. Historically, FAA has amended regulations to impose more stringent flammability requirements for interior cabin furnishings. The current flammability standards limit the amount of heat that can be released and smoke that can be emitted when components are exposed to fire. This standard provides additional time for passengers trapped in a burning aircraft to escape and, in turn, allows more passengers to survive.

The standard for aircraft interior materials, adopted in 1948, required a flammability test to show that materials were slow burning while in a horizontal position and subjected to a small flame. In 1967 FAA issued a new rule requiring a vertical flammability test lasting 12 seconds. In 1972 FAA adopted a standard specifying that all large components be self-extinguishing in a vertical position when subjected to a small flame for 60 seconds. Although these standards addressed small ignition sources—a condition that might accidentally occur while the aircraft was in flight—they did not reflect the intense fire conditions and hazards present during a post-crash cabin fire.

Post-crash cabin fire tests conducted by FAA indicate that the greatest threat to passenger survival is flashover and that toxic gases do not reach hazardous levels unless flashover occurs. Flashover is caused primarily by the heat released by burning interior panels that have large surface areas

[1]Flashover occurs when certain gases and other products emitted during the combustion process are trapped in the upper portions of the cabin and ignite spontaneously.

and, in some cases, are located in the upper cabin where fire temperatures are the highest. Aircraft cabin interior materials with reduced rates of heat release will delay or prevent the onset of flashover.

In 1986 FAA upgraded the fire safety standards for cabin interior materials in transport airplanes by establishing a new test method to determine the heat release from materials exposed to radiant heat and setting allowable criteria for heat release rates. Also in 1986, the Aerospace Industries Association of America and the Air Transport Association (ATA) jointly petitioned FAA for consideration of different test procedures and acceptance criteria. In essence, the joint petition would have relaxed the FAA proposed heat release criteria, required a smoke release test, and delayed compliance with the proposed standards for 3 years. Subsequently, FAA reopened the public comment period on the flammability standards.

Virtually all commenters, including organizations representing various domestic and foreign aircraft manufacturers and operators, supported the intent of the flammability standards to increase aircraft fire safety, and many commenters supported the standards established in 1986. Other commenters, however, expressed concerns regarding the viability of the test methods, availability of suitable materials, and cost of compliance. In 1988 FAA again upgraded the flammability standards by (1) refining the heat release test procedures, (2) establishing a new test method to determine the smoke emission characteristics of cabin materials and setting allowable criteria for smoke emission rates, and (3) allowing additional time for certain components to comply with the standards.

Materials for all larger interior surfaces installed above the floor—including ceilings, sidewalls, bins and partitions, and galley structures—and any coverings on these surfaces have to comply with the heat release and smoke emission standards. Smaller items, such as windows, window shades, or curtains are not included. Floor coverings, floor structures, and such service items as pillows and blankets do not have to meet the new standard. Seats are not included because FAA has established different standards for the flammability of seat cushions. In addition to undergoing the testing required to meet the new flammability standards, interior materials still have to meet the vertical burn test.

The new flammability standards apply to aircraft manufactured under part 25 and operated under parts 121 (large passenger and cargo aircraft) and 135 (smaller passenger and cargo aircraft) of the Code of Federal

Regulations. Aircraft manufactured after August 19, 1988, but before August 20, 1990, had to comply with an interim heat release standard, as did any existing aircraft upon the first substantially complete replacement of the cabin interior components during that period. The new heat release and smoke emission standards applied to all aircraft manufactured after August 19, 1990; aircraft in service on this date are required to comply when they undergo the first substantially complete replacement of the cabin interior components.

Objectives, Scope, and Methodology

In a July 24, 1991, letter and subsequent agreements, the Chairman and Ranking Minority Member, Subcommittee on Aviation, House Committee on Public Works and Transportation, and Representative John D. Dingell asked us to provide information on FAA's emergency evacuation standards for aircraft certification and the U.S. airline industry's compliance with FAA's flammability standards for materials used in aircraft cabin interiors. We received a similar request from the Chairmen, Senate Committee on Commerce, Science, and Transportation and its Subcommittee on Aviation on December 18, 1991. We agreed to address the emergency evacuation issue after completing our work on FAA's flammability standards. Specifically, we were requested to provide information on the

- proportion of the U.S. aircraft fleet that meets or is expected to meet FAA's flammability standards through 1999,
- estimated cost if all aircraft had to meet the standards by certain hypothetical dates, and
- projected safety benefits of meeting the standards under each hypothetical date.

We limited the scope of our analysis to large aircraft operated by domestic commercial airlines. We selected the end of 1994, 1996, and 1999 as the hypothetical dates for all aircraft in the fleet to meet the standards. The year 1999 was selected because we were requested to estimate the number of aircraft that will meet the standards through 1999, and our analyses were dependent on these projections. The years 1994 and 1996 were selected to show general trends in the costs and benefits through 1999. We focused our cost analysis on the typical costs associated with modifying an aircraft's interior—components, labor, and revenue losses resulting from the aircraft's unavailability. Our analysis of safety benefits focused on the potential lives that could be saved as a result of the flammability standards. Since our analyses are based on information that represents a snapshot of an industry that is continually undergoing change, the

projections should be regarded as reflections of general trends rather than specific predictions for the future.

To estimate the proportion of the U.S. fleet that meets or is expected to meet FAA's flammability standards each year through 1999, we relied on data provided to us by ATA. Airlines represented by ATA account for over 80 percent of the U.S. aircraft fleet and about 97 percent of the scheduled airline traffic in the United States. In April 1992 ATA completed a survey to determine how quickly materials meeting the new flammability standards will be installed in ATA members' fleets. We analyzed ATA's projections for aircraft deliveries and retirements to determine the percentage of ATA's fleet that met the standards at the end of 1991 and were expected to meet the standards each year through 1999. Our analysis of ATA's projections was extrapolated to FAA's forecast for the entire U.S. fleet of large transport aircraft to project the number of aircraft that met or are expected to meet the latest flammability standard through 1999.

We also estimated the total cost to equip the aircraft fleet with cabin interiors that meet the flammability standards. To do so, we used the results of our analysis of the aircraft fleet to determine the total number of aircraft that would need to be modified by the end of 1994, 1996, and 1999. Under each of these three compliance dates, we assumed that an equal number of aircraft would be modified each year and that modifications would generally occur during an aircraft's heavy airframe maintenance inspection, which may occur earlier than would otherwise have occurred without a compliance date.

Our estimates of the total cost to replace cabin interiors are based on the results of a 1991 ATA survey of aircraft operators and vendors on the typical costs of cabin interior components that have met the latest standards and the labor hours and aircraft downtime needed to install the components. We discussed aircraft maintenance practices with officials of American Airlines, Delta Air Lines, United Airlines, and USAir to determine the extent that they refurbish, rather than replace, components during a normal maintenance inspection and to estimate the costs that airlines typically incur to refurbish components. These 4 air carriers accounted for about half of the more than 4,200 aircraft in the U.S. fleet at the beginning of 1992.

The total cost estimates shown in this report reflect the additional, or incremental, cost that airlines would likely incur to comply with the new flammability standards. The estimate includes the difference between the

costs for components that meet the new standards and the costs to refurbish components that do not meet the new standards. Airlines would incur additional labor costs and lost revenue to modify aircraft not normally scheduled for modifications in any given year. Also, additional labor costs would be incurred to remove and replace any portion of an aircraft cabin's interior that was not scheduled for removal during a normal maintenance inspection.

To project the safety benefits under each compliance alternative, we assumed a proportional relationship between the percentage of aircraft in the fleet that would comply with the standards and the potential lives that could be saved. We relied on FAA's estimate that from 9 to 16, or an average of 12.5, lives could potentially be saved each year if all large transport aircraft operated by U.S. carriers were equipped with interiors that met the improved flammability standards. Thus, if 50 percent of the fleet complied with the standard, an average of 6.25 lives could potentially be saved each year. To compare the alternatives, we projected the potential fatalities avoided under each alternative for the period 1992 through 2018. We also estimated the value of the safety benefits during this period by using a value of $1.5 million per fatality avoided—the current value of life that the Department of Transportation (DOT) and FAA use in economic analyses supporting rulemakings or investment decisions. We concluded that $1.5 million was reasonable after reviewing research documents and discussing the basis for the value with DOT and FAA officials.

Finally, our cost estimates and projected safety benefits were adjusted to reflect increases through 1999 based on a consensus of anticipated inflation during the period. To compare the alternatives, we computed the present value of the adjusted costs and benefits using a 7.5-percent discount rate, which represents the approximate federal government borrowing rate in the long run. The estimated costs and projected benefits shown in this report reflect the present values of adjusted costs and benefits.

We performed our work between August 1991 and September 1992 in accordance with generally accepted government auditing standards.

We provided a draft of this report to DOT for comment. However, DOT decided to provide oral comments. We incorporated DOT's and FAA's comments as appropriate to improve the technical accuracy and clarity of our report. In addition, chapter 3 contains specific comments offered by DOT and FAA and our responses.

Airlines Will Continue to Operate Aircraft That Do Not Meet the Flammability Standards

In proposing the stricter flammability standards, FAA anticipated that almost 85 percent of the aircraft in the U.S. fleet would comply by 2000. At the beginning of 1992, 11 percent of the U.S. aircraft fleet was equipped with cabin interiors meeting the latest flammability standards—all were newly manufactured aircraft. Airlines have not and do not plan to replace the cabin interiors of existing aircraft to meet the standards. Although the proportion of the fleet that meets the standards is expected to increase, 45 percent of the U.S aircraft fleet is still not expected to do so by the end of the decade.

Few Aircraft Currently Meet the Flammability Standards

Aircraft manufactured after August 19, 1990, are required to meet the latest flammability standards for cabin interiors. Since that date, manufacturers have produced an estimated 470 aircraft that are currently operated by U.S. airlines. These aircraft represented about 11 percent of more than 4,200 aircraft in the U.S. fleet at the beginning of 1992.

Aircraft in service on August 19, 1990 (in-service aircraft), are only required to meet the flammability standards upon the first substantially complete replacement of their cabin's interior components. However, FAA has not precisely defined what constitutes a substantially complete replacement of interior components. According to FAA officials, the intent of the rule was that the components need only meet the new standards when the interior components are, for all practical purposes, completely replaced. Airline officials told us that, essentially, all components subject to the rule must be replaced before they would comply with the rule. FAA officials told us that FAA inspectors monitor aircraft undergoing maintenance and modifications and will notify the airline when they believe that the replacement of interiors with components meeting the standards would be warranted.

When the flammability standards went into effect, almost 4,200 aircraft existed in the U.S. aircraft fleet. ATA's April 1992 survey indicated that no aircraft had been modified to meet the flammability standards by the beginning of 1992. FAA Flight Standards Service officials were not aware of any aircraft that had been brought into compliance with the standards as of July 1992. Also, officials of four major domestic airlines told us that they had not completely replaced the interiors of any aircraft to meet the flammability standards.

Airlines Do Not Plan to Voluntarily Replace Cabin Interiors

FAA did not mandate that the in-service U.S. aircraft fleet be retrofitted with cabin interior components that met the improved flammability standards.[1] In proposing the standards, FAA indicated that the financial burden on the airlines would be reduced if they introduced new materials during normal interior replacement cycles. FAA expected that air carriers would continue to voluntarily replace interiors in aircraft that already came close to meeting the standards. Moreover, FAA expected that many aircraft would be retired from service because of noise restrictions and obsolescence and that air carriers would completely replace the interiors of most of the remaining aircraft for other such reasons as wear or modernization. Overall, FAA expected that almost 85 percent of the aircraft in the U.S. fleet would meet the new standards by 2000 as a result of both voluntary and FAA-mandated actions. In its regulatory evaluation of the proposed rule, FAA anticipated that about 48 percent of the fleet would meet the standards voluntarily and about 37 percent as a result of the FAA mandate.[2] FAA indicated that it would consider proposing a mandatory retrofit requirement if materials not meeting the new standards remained in service in a significant number of aircraft because routine interior replacements were not accomplished as anticipated and a substantial increase in overall safety could be realized.

Industry's practice is to complete as much work as possible during heavy airframe maintenance and modifications.[3] According to Flight Standards Service officials, FAA intended that the flammability standards would be applied to aircraft that undergo major modifications, such as design reconfigurations and changes in seating configuration. These modifications occur infrequently and generally require a supplemental aircraft type certification or an airline engineering order that requires the aircraft's entire interior to be removed and/or replaced.

Although FAA did not intend for airlines to modify aircraft to comply with the flammability standards during routine heavy maintenance inspections, these inspections provide airlines with an opportunity to replace cabin interiors in the existing fleet. The principal heavy maintenance visit is the

[1]For purposes of this report, "in-service aircraft" refers to aircraft in service on Aug. 19, 1990, that did not meet the standards.

[2]Regulatory Evaluation, Regulatory Flexibility Determination, and Trade Impact Assessment: Improved Flammability Standards for Materials Used in the Interiors of Airplane Cabins, FAA Office of Aviation Policy and Plans, Dec. 1985.

[3]Heavy airframe maintenance, repair, and modifications include (1) routine airframe maintenance, (2) FAA-mandated inspections and modifications (such as those for aging aircraft and noise requirements), and (3) nonmandated modifications (such as fleet standardization, cabin refurbishment, and reconfiguration).

"D" check. D checks typically include completing work to address all FAA-mandated and rule requirements before their compliance dates; all periodically scheduled maintenance required by the airline's FAA-approved maintenance plan; manufacturer's service bulletins that the carrier has chosen to implement at its discretion; marketing modifications to improve the aircraft's appearance, comfort, or passenger convenience; and the standardization and/or improvement of major aircraft components to improve safety. According to officials of four major airlines, a D check or equivalent inspection is performed at least once every 7 to 8 years, depending on the airline. Therefore, almost all of the aircraft not expected to meet the flammability standards would have at least one opportunity between 1992 and 1999 to replace cabin interiors to meet the standards.

Many of these aircraft would also undergo extensive modifications to meet aging aircraft and noise requirements between 1992 and 1999. FAA requires that all older aircraft in the fleet—about 1,400 in 1991—undergo structural modifications by mid-1994. The Airport Noise and Capacity Act of 1990 requires that older, noisy aircraft be modified to meet stricter noise standards by the end of the decade or be retired. At the end of 1991, about 2,000 of these aircraft remained in the U.S. fleet. Although the airlines plan to dispose of about 1,300 existing airplanes between 1992 and 1999, they also plan to modify about 550 of the noisy or aging aircraft. These 550 aircraft represent over 20 percent of the aircraft that will not meet the flammability standards at the end of 1999. However, the airlines do not plan to replace the cabin interiors in aircraft when they undergo noise or aging aircraft modifications.

Since the flammability standards went into effect, we estimated that airlines had performed a D check or equivalent maintenance inspection on about 1,000 aircraft. However, airlines have not completely replaced the cabin interiors with components meeting the standards in any of these aircraft. Officials from the four airlines we contacted said they do not normally remove the cabin's entire interior during a heavy maintenance inspection. Three of the four airlines use a phased maintenance approach in which only certain areas of the aircraft are inspected according to a sampling plan that specifies the section to be inspected and the number of aircraft undergoing heavy maintenance to be included in the inspection. For these aircraft, airlines remove only that portion of the interior necessary to allow the inspection. Sampling allows the airlines to project the condition of the section inspected in the sampled aircraft to the airlines' entire fleet. The fourth airline indicated that it removed all interior components, except for the overhead storage bins, to facilitate the

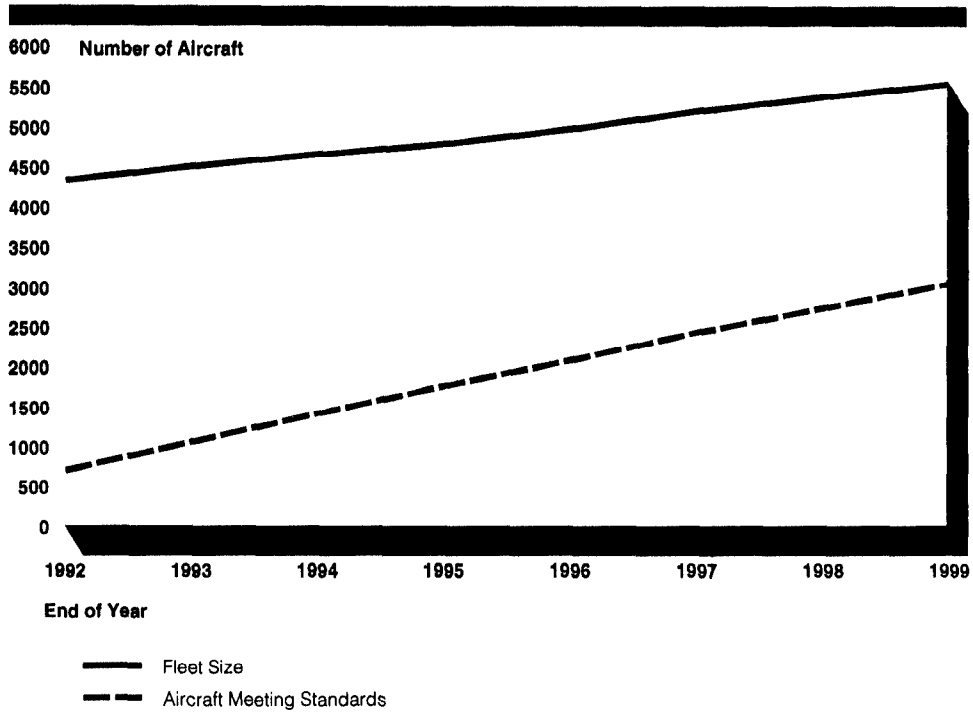
inspection of the entire airframe structure. All four airlines stated that the overhead storage bins are seldom removed during a heavy maintenance inspection because it is too time-consuming and expensive to remove and replace them. The airline officials also stated that the interior components that are removed are typically cleaned, repaired or recovered, and reinstalled in the same aircraft.

However, airlines are selectively replacing some interior materials on a piecemeal basis. According to ATA and the four airlines we contacted, individual components, such as a sidewall panel, that have worn out or are beyond refurbishment are replaced by materials meeting the latest flammability standards. In addition, airlines will replace the decorative coverings or tapestries on panels and partitions with materials that meet the new standards. In such cases, however, the backings are not replaced; therefore, the upgraded panels and partitions do not meet the standards. According to ATA, the airlines are buying materials that comply with the latest standards whenever they replace materials or an entire component. Because of this selective replacement of interior materials, the aircraft fleet will contain a mixture of interior components, some of which will and will not meet the latest flammability standards. According to FAA officials, the replacement of individual components on a piecemeal basis would not significantly reduce the risk posed by a post-accident fire.

Many Aircraft Are Not Expected to Meet the Standards by the End of the Decade

ATA's survey indicates that newly manufactured aircraft will be the only source of aircraft with cabin interiors that meet the stricter flammability standards. The proportion of the U.S. fleet that meets the standards is expected to increase each year as new aircraft replace older aircraft in the fleet. On the basis of the percentage of aircraft belonging to ATA members expected to meet the standards, we estimate that over 1,400 aircraft, or 30 percent of the U.S. fleet, will meet the flammability standards by the end of 1994; about 2,100 aircraft, or 42 percent of the fleet, by the end of 1996; and over 3,000 aircraft, or 55 percent of the fleet, by the end of 1999. Figure 2.1 shows the number of aircraft in the U.S. fleet projected to meet the flammability standards between 1992 and 1999.

Figure 2.1: Aircraft in Fleet Projected to Meet the Flammability Standards, 1992-99



Source: GAO's analysis of ATA's and FAA's data.

As shown in figure 2.1, about 2,500 aircraft, or 45 percent of the domestic fleet, are not expected to comply with the flammability standards almost 10 years after they went into effect. These aircraft were in service at the time the standards went into effect, and FAA expected that airlines would either retire the aircraft or voluntarily replace their interiors by the end of 1999. Although airlines plan to retire an estimated 1,300 aircraft between 1992 and 1999, they expect to retain an estimated 60 percent of the aircraft in use when the flammability standards went into effect. According to ATA's survey, the airlines do not plan to voluntarily replace the cabin interiors in these aircraft to meet the flammability standards. In addition, ATA officials told us that FAA's mandating that airlines comply with the flammability standards would not be cost-effective. Under the airlines' current practice of replacing, rather than modifying, aircraft, the entire fleet is not expected to comply with the stricter flammability standards until 2018 at the earliest.

Estimated Costs and Safety Benefits of Meeting Flammability Standards

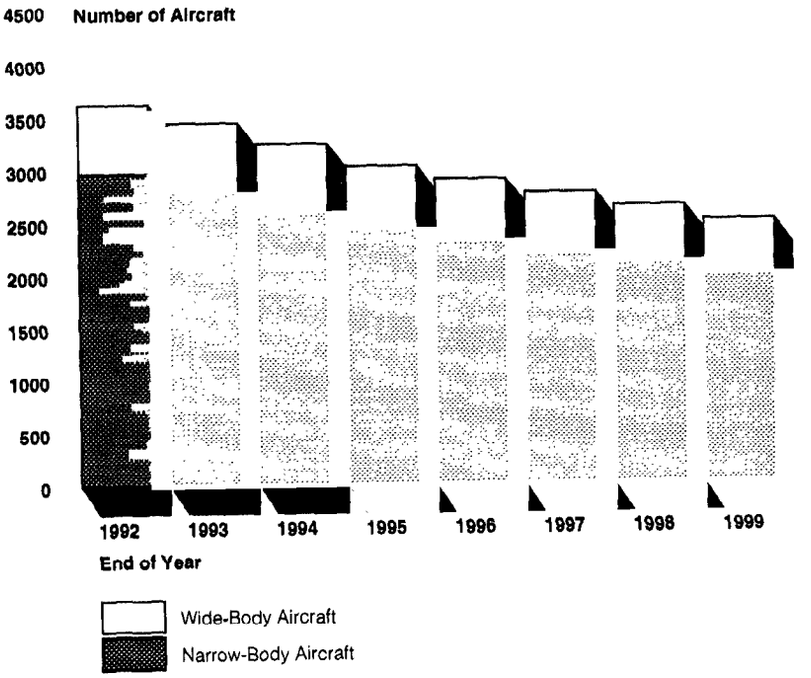
The U.S. aircraft fleet will likely not meet the stricter flammability standards for aircraft cabin interiors by the end of the decade as FAA anticipated. However, a decision to mandate that all aircraft in the fleet comply with the stricter flammability standards by a specific date will have to consider the number of aircraft needing modification, additional costs to the airlines, and potential lives saved as a result of modifying the aircraft fleet. Under the 1994, 1996, and 1999 hypothetical cases, about 3,200 aircraft, 2,900 aircraft, and 2,500 aircraft, respectively, would need to be modified. The total cost (in present value) to modify these aircraft by the end of 1994, 1996, and 1999 would be about $3.8 billion, $3.1 billion, and $2.5 billion, respectively.

Although the costs to the airline industry can be reliably estimated, more uncertainty exists in estimating potential lives saved and their value. First, historical data cannot be used to reliably project future fatalities because airline accidents occur infrequently and unpredictably and relatively few accidents have involved fire. Second, no consensus exists on the value of a human life. Nevertheless, on the basis of historical accident data, FAA estimates that 9 to 16 lives could potentially be saved each year if all aircraft met the flammability standards. Using FAA's estimate, between 75 and 100 fatalities could potentially be avoided through 2018 as a result of modifying aircraft to meet the standards. If DOT's value of $1.5 million for a human life were used, the fatalities potentially avoided would have a present value of $80 million to $110 million.

Aircraft Needing Modification

At the beginning of 1992, an estimated 3,800 aircraft, or 89 percent of the U.S. aircraft fleet, did not have cabin interiors that met the latest flammability standards. Although airlines plan to retire an estimated 1,300 aircraft between 1992 and 1999, they plan to retain an estimated 2,500 aircraft, or about 60 percent of the aircraft in service when the flammability standards went into effect. Figure 3.1 shows the number of narrow-body and wide-body aircraft in the U.S. fleet projected not to meet the flammability standards between 1992 and 1999.

Figure 3.1: Aircraft in Fleet Projected Not to Meet the Flammability Standards, 1992-99



Source: GAO's analysis of ATA's and FAA's data.

Modifications Would Cost Several Billion Dollars

The airline industry would incur costs of several billion dollars to modify aircraft not meeting the flammability standards. The major costs incurred by the airline industry would be for components and labor. In addition, an airline could lose revenue while the aircraft is out of service during the modifications. Table 3.1 shows the estimated total costs (in present value) for the components, labor, and lost revenue to modify the aircraft in the fleet projected not to meet the flammability standards by the end of 1994, 1996, and 1999.

Table 3.1: Estimated Total Cost to Modify Aircraft With Cabin Interiors That Meet the Flammability Standards

Dollars in millions

	Compliance year		
	1994	**1996**	**1999**
Aircraft needing modification	3,200	2,900	2,500
Present value cost to modify aircraft[a]			
Components[b]	$3,167	$2,744	$2,257
Labor	401	344	241
Lost revenue	217	38	0
Total	**$3,785**	**$3,126**	**$2,498**

[a]Discounted to present value at 7.5 percent.

[b]Cost difference between new components meeting the standards and refurbished components not meeting the standards.

Source: GAO's analysis of ATA's, FAA's, and the airlines' data.

Component Cost

All larger interior surface components installed above the floor are subject to the new flammability standards, including ceilings, sidewalls, bins and partitions, galley structures, and coverings on these components. A 1991 ATA survey showed that the typical costs for cabin interior components meeting the latest flammability standards ranged from $515,000 for a narrow-body to $3.5 million for a wide-body aircraft. To replace interiors in aircraft at the end of 1994, 1996, and 1999, we estimate that the airlines would spend about $3.5 billion, $3 billion, and $2.5 billion, respectively, for new components meeting the standards.

During heavy maintenance inspections, however, airlines would incur cost to refurbish cabin interior components not meeting the standards, rather than costs to replace them with components that meet the standards. On the basis of discussions with officials of four major airlines, we estimated that the cost to refurbish interior components is about one-tenth of the cost of new components that meet the flammability standards. We estimated that the airlines would spend about $350 million, $300 million, and $250 million to refurbish existing interior components in aircraft by the end of 1994, 1996, and 1999, respectively.

The difference between the cost for new components and the cost to refurbish existing components reflects the additional, or incremental, cost for components that airlines would incur as a result of implementing the

latest flammability standards. As shown in table 3.1, the cost difference between new components meeting the standards and refurbished components not meeting the standards would be about $3.2 billion, $2.7 billion, and $2.3 billion under the hypothetical 1994, 1996, and 1999 compliance dates, respectively.

Labor Cost

In its 1991 survey, ATA estimated that the labor cost to install interior components would be $110,000 (2,000 labor hours at $55 per hour) for a narrow-body aircraft and $275,000 (5,000 labor hours at $55 per hour) for a wide-body aircraft. Airlines would incur these costs for all aircraft needing modification that exceeded the number of aircraft that could normally be scheduled for heavy maintenance inspection. Assuming a 7-year normal maintenance cycle for the over 3,600 aircraft not meeting the standards at the end of 1992, we estimated that over 500 aircraft could normally be scheduled for modification each year.

During a normal maintenance inspection, airlines would already incur some labor cost to remove and reinstall interior components. Therefore, only a portion of ATA's estimated labor cost would be additional cost attributable to replacing the entire interior with components meeting the flammability standards. On the basis of discussions with airline officials, we estimated that 75 percent of the labor cost would be the additional cost required to replace interior components. For the aircraft that could be modified under a normal maintenance cycle, our analysis assumes that the additional labor cost required to replace interior components would be about $83,000 for a narrow-body aircraft and $206,000 for a wide-body aircraft.

Lost Revenue

Generally, an airline would lose revenue when an aircraft is out of service because the interior is being replaced with components that meet the flammability standards. ATA estimated that a narrow-body aircraft would be out of service about 2 to 3 weeks and a wide-body aircraft would be out of service about 3 to 4 weeks for modifications. However, a normal heavy maintenance inspection may take from 2 to 8 weeks to perform, which includes time to remove and reinstall a portion of the interior components and to refurbish other components. Since a normal heavy maintenance inspection already includes time to refurbish components, an airline would not typically lose revenue to replace components if the modifications are scheduled during the normal maintenance cycle. Therefore, our analysis assumes that an airline would lose revenue from

an aircraft's being out of service only when modifications occur outside of the normal maintenance cycle. For example, airlines would lose revenue on about 600 aircraft a year under the 1994 alternative because over 500 of the 1,100 aircraft needing modification each year could be modified during the normal maintenance cycle. In this example, if fewer than 500 of the aircraft were modified during the normal maintenance cycle, then the amount of lost revenue would be higher.

According to ATA officials, in 1991 airlines lost several thousand dollars per day for each aircraft out of service for maintenance inspection. Assuming that an aircraft would be out of service for 3 weeks, or 21 days, and that the airlines would lose $6,000 per aircraft each day, the total lost revenue per aircraft would have been $126,000 in 1991. On the basis of the lost revenue per aircraft and the number of aircraft that would be modified at a time other than during a normal maintenance cycle, we estimated that airlines would lose revenue of about $220 million and $40 million to modify aircraft by the end of 1994 and 1996, respectively. Since all aircraft could be modified during a normal maintenance cycle under the 1999 compliance year, airlines would not be expected to lose revenue from aircraft being out of service.

Cost Impact Would Be Reduced by Extending the Compliance Period

The total cost to modify the domestic aircraft fleet to meet the flammability standards would decline if the compliance period were extended over more years. Total costs would decrease each year because fewer aircraft would be modified as airlines retire additional aircraft. As reflected in figure 3.1, airlines plan to retire about one-third of their in-service aircraft between 1992 and 1999. The number of aircraft that would need to have their cabin interiors replaced declines from about 3,200 under the 1994 alternative to about 2,500 under the 1999 alternative. As a result, total costs to modify the domestic fleet would decline by about $1.3 billion between 1992 and 1999.

In addition, any annual financial burden on the airlines would be reduced under the later compliance years because the costs would be spread over many more years. Under each of the alternatives we examined, the average cost to modify each aircraft would be over $1 million. However, the number of aircraft requiring modification and the cost incurred by the airlines each year would decline if modifications were spread out over more years. Under the 1994 alternative, for example, airlines would have to modify about 1,100 aircraft a year for 3 years, at an average cost of $1.3 billion each year. In contrast, airlines would have to modify about 300

aircraft a year for 8 years under the 1999 alternative, at an average cost of $312 million each year.

Modifications Would Potentially Save Lives

The increased likelihood of surviving a post-crash fire is the safety benefit of replacing aircraft cabin interiors with components that meet the flammability standards. Safety benefits would be realized in an unpredictable manner; that is, fatalities could be avoided in accidents occurring relatively soon or 20 years from now. Because aircraft accidents occur infrequently and unpredictably, substantial uncertainty is associated with any estimate of potential fatalities. One or two significant accidents could result in the loss of hundreds of lives.

FAA Fire Tests Demonstrated Safety Benefits

Full-scale fire tests conducted by FAA demonstrated the potential safety benefits of aircraft cabin interior components that meet the improved flammability standards. The improved standards would provide additional time for passengers trapped in a burning airplane to escape, allowing more passengers to survive.

Before proposing the improved flammability standards, FAA conducted full-scale fire tests in a C-133 aircraft, modified to resemble a wide-body interior, under post-crash and in-flight fire conditions. FAA evaluated the different characteristics of in-service panels that did not meet the new standards and advanced design panels that met the stricter flammability standards. The advanced design panels delayed the onset of flashover for 2 minutes when the cabin fire was initiated by a fuel fire adjacent to a fuselage rupture. The panels also eliminated flashover when a fuel fire was adjacent to a door opening or when an in-flight fire was started from a seat drenched in gasoline. On the basis of these tests, FAA concluded that advanced interior panels can provide a significant safety improvement during post-crash and in-flight fires. In fact, FAA estimated that the stricter flammability standards could provide 17 additional seconds for occupants to escape, allowing more passengers to escape.

FAA estimated that from 9 to 16 lives, or an average of 12.5 lives, could potentially be saved each year if all aircraft operated by U.S. airlines were equipped with interiors that meet the improved flammability standards. FAA's estimate was derived from escape time and survivability data contained in a National Bureau of Standards study of commercial

accidents worldwide in which fire was a factor in fatalities.[1] Although quantifying the value of human life is controversial and subjective, DOT currently advocates a value of $1.5 million for each potential fatality avoided.

Safety Benefits of Replacing and Modifying Aircraft

Our analysis relies on FAA's estimate of potential lives saved and DOT's value for a human life to estimate the (1) potential safety benefits of meeting the flammability standards by replacing older aircraft with new aircraft through 2018 and (2) additional safety benefits of modifying older aircraft to meet the standards by the end of 1994, 1996, and 1999. Depending on the number and severity of accidents, however, the number of potential lives saved and the total value of these lives could be higher or lower than shown in our analysis. However, our analysis demonstrates that the sooner that all aircraft in the fleet comply with the flammability standards, the more rapidly the safety benefits will likely be realized. Table 3.2 shows the potential fatalities avoided by replacing aircraft through 2018 and the additional potential fatalities avoided by modifying aircraft under the hypothetical 1994, 1996, and 1999 compliance dates, assuming FAA's estimate of the average number of lives saved each year and the percentage of aircraft that would meet the standards for the period 1992 through 2018.

Table 3.2: Potential Fatalities Avoided Between 1992 and 2018 by Replacing or Modifying Aircraft to Comply With Standards

Dollars in millions

	Benefits of replacing aircraft by (year)	Additional benefits of modifying aircraft by (year)		
	2018	1994	1996	1999
Potential fatalities avoided	200	100	90	75
Present value of potential fatalities avoided	$180	$110	$100	$80

Source: GAO's analysis of ATA's and FAA's data.

Under the airlines' current practice of replacing older aircraft with new aircraft to meet the standards, the entire aircraft fleet will not comply with the stricter flammability standards until 2018 at the earliest. Between 1992 and 2018, an estimated 200 lives could potentially be saved as a result of

[1]Decision Analysis Model for Passenger-Aircraft Safety With Application to Fire Blocking of Seats, National Bureau of Standards, Apr. 1984.

replacing aircraft that do not meet the standards with new aircraft that meet the standards. These lives would have a present value of about $180 million.

However, additional fatalities could potentially be avoided if aircraft were modified to comply with the stricter flammability standards before 2018. As a result of modifying aircraft not meeting the standards by the end of 1994, 1996, and 1999, an estimated 100, 90, and 75 additional fatalities, respectively, could potentially be avoided between 1992 and 2018. The estimated present value of the additional fatalities avoided by modifying aircraft to meet the standards under the hypothetical 1994, 1996, and 1999 compliance dates would be about $110 million, $100 million, and $80 million, respectively.

The total potential fatalities that could be avoided by replacing and modifying aircraft between 1992 and 2018 so that the entire fleet complies with the flammability standards by the end of 1994, 1996, and 1999 are about 300, 290, and 275, respectively. The present value of the fatalities potentially avoided under the hypothetical 1994, 1996, and 1999 compliance dates would be $290 million, $280 million, and $260 million, respectively.

Conclusions

The U.S. aircraft fleet will likely not meet the flammability standards for aircraft cabin interiors by the end of the decade as FAA anticipated. Under the current practice of replacing, rather than modifying, aircraft, the entire fleet is not expected to comply with the stricter standards until 2018. To achieve earlier compliance, FAA would need to revise its regulations to mandate a retrofit of all aircraft not meeting the flammability standards by a specific date. Given the slippage in FAA's original estimate of when the entire fleet would meet the stricter flammability standards, FAA should reassess whether to issue a regulatory requirement mandating a specific date for compliance with the flammability standards for aircraft cabin interiors. A decision to mandate a specific date when the U.S. aircraft fleet should meet the stricter flammability standards will have to consider the additional costs to the airlines and potential lives saved as a result of mandating compliance. The information contained in this report should help FAA to reassess the cost-effectiveness of retrofitting aircraft by a specific date. However, the decision will not be clear-cut and will have to be weighed against other actions that could improve the overall safety of the U.S. aircraft fleet.

Recommendation

We recommend that the Secretary of Transportation direct the Administrator, FAA, to reassess whether to issue a regulatory requirement mandating a specific date for all aircraft in the fleet to comply with the latest flammability standards for cabin interiors. Such a reassessment should compare the cost-effectiveness of retrofitting aircraft to meet the standards with other actions that could improve the overall safety of the U.S. aircraft fleet.

Agency Comments and Our Evaluation

FAA's Deputy Director, Aircraft Certification Service, and other DOT officials do not believe that a reassessment of the flammability standards is warranted. FAA officials stated that our findings, as well as an internal FAA cost analysis of refurbishing aircraft cabin interiors, indicate that the costs to retrofit the fleet outweigh the potential safety benefits; therefore, mandating a retrofit requirement would not be cost-effective.

As we indicated, cost is an important factor in considering any action to improve safety. However, we recognize that other factors could have a greater influence on a decision to implement an action. For example, FAA established the current flammability standards for cabin interiors to achieve a safety objective even though its analysis of estimated costs exceeded the estimated dollar value of benefits. Moreover, in the Notice of Proposed Rulemaking and regulatory evaluation for the current standards, FAA anticipated that about 85 percent of the fleet would meet the standards by 2000 and indicated that it would consider mandating a retrofit requirement if components not meeting the standards remain in service in a significant number of aircraft and a substantial increase in overall safety could be realized. Since 45 percent of the U.S. aircraft fleet will likely not meet the stricter flammability standards by the end of the decade and additional benefits will likely be realized the sooner that all aircraft in the fleet comply with the standards, we believe that FAA should reassess whether to issue a regulatory requirement mandating a specific date for compliance with the flammability standards for aircraft cabin interiors.

Improvements in Aircraft Cabin Safety

In recent years, the Federal Aviation Administration (FAA) has implemented a series of new standards to improve aircraft cabin safety. This appendix summarizes those standards as described in FAA's Aviation Safety Journal, Summer 1991, Vol. 1, No. 3. Today, FAA is conducting full-scale fire tests to evaluate the effectiveness of an onboard water-spray fire-suppression system.

Heat-Resistant Evacuation Slides

Emergency evacuation slides manufactured after December 3, 1984, must be fire-resistant and comply with a new radiant heat testing procedure.

Airplane Cabin Fire Protection

This rule requires improved lavatory fire protection and the installation of Halon 1211, or equivalent, hand-held fire extinguishers in the passenger cabin. At least two Halon fire extinguishers were to be installed in each airplane by April 29, 1986. Lavatory smoke detectors were to be installed by October 29, 1986. Lavatory waste receptacles were to be outfitted with a built-in fire extinguisher by April 29, 1987.

Floor Proximity Emergency Escape Path Marking

Airplane emergency lighting systems must visually identify the emergency escape path and identify each exit from the escape path. Large transport airplanes were to comply by November 26, 1986.

Flammability Requirements for Aircraft Seat Cushions

Airplane seat bottoms and back cushions must meet a more stringent flammability test than previously required to reduce the rate at which fire can spread in an aircraft. The aircraft of air carriers, air taxis, and commercial operators were required to comply by November 26, 1987.

Seat-Safety Standards

This rule upgrades the standards for occupant protection during emergency landing conditions in transport aircraft by revising the seat-restraint requirements and defining impact injury criteria. The new seat restraint standards relate to all transport aircraft applying for FAA certification on or after June 16, 1988.

Flammability Standard for Aircraft Cabin Interiors

This rule requires that interior components with large outer surface areas meet a rate-of-heat-release flammability standard on the basis of a test developed at Ohio State University. Aircraft manufactured on or after August 20, 1988, but before August 20, 1990, had to meet an interim standard using the new testing method. Aircraft manufactured on or after

August 20, 1990, were required to meet the new standard. In-service aircraft certified after January 1, 1958, that undergo a substantially complete replacement of the cabin interior on or after August 20, 1990, must also meet the new standard.

Protective Breathing Equipment

Aircraft must be equipped with protective breathing equipment to protect flight attendants from smoke while using fire extinguishers in fighting on-board fires. The requirement had to be met by July 6, 1989.

Location of Passenger Emergency Exits

This rule improves passenger evacuation in an emergency by limiting the distance between adjacent emergency exits on transport airplanes to 60 feet. This rule became effective on July 24, 1989.

Exit Row-Seating

This rule requires that persons seated next to emergency exits must have the physical and mental capability to operate the exit and possibly assist other passengers in emergency evacuations. This rule became effective on October 5, 1990.

Independent Power Source for Public Address System

This rule requires that the public address system be independently powered for at least 10 minutes and that at least 5 minutes of that time is during announcements. This requirement improves safety by ensuring that the emergency public address system will not have to rely on engine or auxiliary-power-unit operation. Air carrier and air taxi airplanes manufactured after November 27, 1990, must comply.

Cargo Compartment Protection

This rule upgraded the fire safety standards for cargo or baggage compartments in certain transport airplanes by requiring the replacement of ceiling and sidewall liner panels that were not constructed of aluminum or glass-fiber-reinforced resin by March 20, 1991. In addition, newly designed airplanes are required to have liners that meet stringent flame-penetration standards.

Access to Type III Exits

This rule requires improved access to the Type III emergency exits (typically smaller over-wing exits) by providing an unobstructed passageway to the exit. Transport aircraft with 60 or more passenger seats must comply with the new emergency exit standards by December 3, 1992.

Onboard Cabin Water-Spray Systems

FAA is currently conducting water spray tests as part of a cooperative program between FAA, the British Civil Aviation Authority, and Transport Canada. The water spray tests are directed at improving passengers' survivability during a post-crash ground fire. Here, the fire threat is hundreds of gallons of burning jet fuel. The burning fuel radiates intense heat; generates thick, black smoke; and causes aircraft interior materials to ignite, inhibiting or preventing occupants from escaping. The purpose of water spray is for passengers to gain additional time to escape by suppressing the interior fire and cooling the cabin environment.

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