DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 23

[Docket No. 27344; Notice No. 93-71]

RIN 2120-AD27

Airworthiness Standards; Occupant Protection Standards for Commuter Category Airplanes

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of Proposed Rulemaking (NPRM).

SUMMARY: The FAA proposes to amend the airworthiness standards for normal, utility, acrobatic, and commuter category airplanes by upgrading the requirements for both seat/restraint systems and for flammability standards for seat cushions used in commuter category airplanes. It also proposes to increase the downward inertia load factor for items of mass within the cabin for all normal, utility, acrobatic, and commuter category airplanes. These amendments are needed to improve the occupant protection provisions for these types of airplanes. These new requirements would result in a level of safety commensurate with that provided by the seat/restraint requirements and the flammability standards for transport category airplanes.

DATES: Comments must be received on or before November 12, 1993.

ADDRESSES: Comments on this notice may be mailed in triplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attn: Rules Docket (AGC-10), Docket No. 27344, 800 Independence Avenue SW., Washington, DC 20591, or delivered in triplicate to: Room 916, 800 Independence Avenue, SW., Washington, DC 20591. Comments delivered must be marked Docket No. 27344. Comments may be inspected in room 916 between 8:30 a.m. and 5 p.m. on weekdays, except on Federal holidays.

In addition, the FAA is maintaining an information docket of comments in the Office of Assistant Chief Counsel, ACE-7, Federal Aviation Administration, Central Region, 601 East 12th Street, Kansas City, Missouri 64106. Comments in the information docket may be inspected in the Office of Assistant Chief Counsel, weekdays, except Federal holidays, between the hours of 7:30 a.m. and 4 p.m.

FOR FURTHER INFORMATION CONTACT: Michael Downs, Aerospace Engineer, Standards Office (ACE-112), Aircraft Certification Service, Small Airplane Directorate, Federal Aviation Administration, 601 East 12th Street, Kansas City, Missouri 64106, telephone (816) 426-5688.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in the making of this proposed rule by submitting such written data, views, or arguments as they may desire. Comments relating to the environmental, energy, or economic impact that might result from adopting the proposals in this notice are invited. Comments should be accompanied by cost estimates. Communications should identify the regulatory docket or notice number and be submitted in triplicate to the address specified above. All communications received on or before the closing date for comments specified above will be considered by the Administrator before taking further rulemaking action. Commenters wishing the FAA to acknowledge receipt of comments submitted in response to this notice must include a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. 27344." The postcard will be date stamped and returned to the commenter. All comments received will be available, both before and after the closing date for comments, in the Rules Docket for examination by interested persons. The proposals contained in this notice may be changed in light of comments received. A report summarizing each substantive public contact with FAA personnel concerned with this rulemaking will be filed in the docket.

Availability of NPRM

Any person may obtain a copy of this NPRM by submitting a request to the Federal Aviation Administration, Office of Public Affairs, Attn: Public Inquiry Center, (APA-200), 800 Independence Avenue SW., Washington, DC 20591, or by calling (202) 267-3484. Communications must identify the notice number of this NPRM. Persons interested in being placed on the mailing list for future NPRMs should also request a copy of Advisory Circular 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

Background

The FAA proposes to upgrade the cabin safety requirements for airplanes certificated in the normal, utility, acrobatic, and commuter categories of part 23 of the Federal Aviation Regulations (FAR). These proposed rules are a continuation of Federal Aviation Administration (FAA) efforts to improve the occupant protection provisions for airplanes that are type certificated to the requirements of part 23.

Seat/Restraint Requirements

Amendment 23-32 (50 FR 46872, November 13, 1985) added requirements for the installation of a shoulder harness at each seat of normal, utility, and acrobatic category airplanes with a passenger seating configuration, excluding pilot seats, of nine or fewer, manufactured after December 12, 1986.

Amendment 23-34 (52 FR 18060, January 15, 1987) added airworthiness standards for the type certification of airplanes in a new commuter category. Those rules limited commuter category airplanes to a maximum seating capacity, excluding pilot seats, of 19 or fewer, and maximum certificate takeoff weight of 19,000 pounds or less. The airworthiness standards adopted for the commuter category were based on requirements previously defined in Special Federal Aviation Regulation (SFAR) 41C.

Amendment 23-36 (53 FR 30802, August 15, 1988) added requirements that seat/restraint systems of new design normal, utility, and acrobatic category airplanes comply with specific occupant protection provisions under dynamic test conditions. Those rules were adopted as a result of the publication of Notice No. 86-19 and the FAA analysis of public comments made to the proposals in that notice. At the time Notice No. 86-19 was being developed, the commuter category airworthiness standards had not been promulgated. Therefore, requirements for shoulder harnesses at passenger seats and seat/restraint system dynamic test conditions were not adopted for commuter category airplanes in amendment 23-36.

In a related action, amendment 25-64 (53 FR 17640, May 17, 1988) added requirements that seat/restraint systems for installation in new design transport category airplanes demonstrate specific occupant protection capabilities under prescribed dynamic emergency landing conditions.

Since the airworthiness requirements adopted for commuter category airplanes in amendment 23-34 did not provide upgraded cabin safety requirements for dynamic testing of seats comparable to those recently adopted for normal, utility, and acrobatic category airplanes, but retained the existing certification requirements of SFAR 41C, the FAA established a project to develop improved occupant protection requirements for commuter category airplanes. In particular, the FAA reviewed the need for dynamic evaluations of seat/restraint systems installed in commuter category airplanes and the need for shoulder harness installations at the passenger seats of those airplanes. This review included an evaluation of the relative size of commuter category airplanes, their general operations, their current required cabin safety provisions, and the level of safety expected by the public.

Generally, commuter category airplanes are intended to operate under part 135 rules to carry passengers for compensation or hire. Also, commuter category airplane designs generally parallel larger twin-engine normal category airplane designs rather than transport category airplane designs used in air carrier operations under part 121 rules. Cabin dimensions for commuter category airplanes, particularly height and width, generally are similar to those of twin-engine normal category airplanes. Most transport category airplanes used in air carrier operations have baggage space below the cabin floor that provides a significant amount of crushable underfloor structure to attenuate peak vertical deceleration levels in the cabin during a crash landing. This is not the case with most commuter category airplanes. An FAA review of the underfloor depth of eleven models of current production airplanes type certificated under SFAR 41 showed that the total underfloor depth varied from 6.3 to 19.0 inches, with an average of about 12 inches. In general, the underfloor structures of those airplanes are not designed to dissipate energy or limit occupant loads during crashes. The design and construction of seats and restraint systems in SFAR 41 airplanes are similar to those of seats and restraint systems used in normal category airplanes. Generally, shoulder harnesses are not available at passenger seats in commuter category airplanes.

During the development of the dynamic test conditions for commuter category airplanes proposed in this notice, the FAA considered the standards now required for dynamic tests of seat/restraint systems in normal, utility, acrobatic, and transport category airplanes. The FAA also reviewed the background and justification of those requirements. The dynamic test conditions and the pass/fail criteria required for seat/restraint systems in normal, utility, and acrobatic category airplanes were proposed originally by the General Aviation Safety Panel (GASP). Those criteria were based on crash data provided by a National Transportation Safety Board (NTSB) Aircraft Accident Report, dated November 23, 1987, data from the FAA Civil Aeromedical Institute (CAMI) Airline Cabin Safety Data Bank Study, and data from full-scale impact tests of normal category airplanes. Those full-scale impact tests were conducted by the National Aeronautics and Space Administration (NASA) as part of a joint FAA/NASA research project.

In this notice, the peak deceleration and time to peak deceleration, for the proposed combined vertical/longitudinal impact condition, were developed by considering a flat-impact crash condition (i.e., the airplane impacts the ground with the airplane longitudinal axis parallel to the ground). That impact condition subjects the seated occupant to a resultant floor pulse that is different from the respective test condition required for seat/restraint systems of normal, utility, or acrobatic category airplanes. The requirements for those small airplanes were developed from recommendations made by the GASP using a typical nose-down crash condition. Information from both NTSB accident data and the NASA full-scale impact test results shows that the flat-impact condition produces higher vertical deceleration rates at the cabin floor than are produced in nose-down impact conditions. In addition, there is a minimal amount of crushable structure available to absorb the impact under flat impact conditions. The amount of crushable structure below the cabin floor is a major factor in determining the amount of energy transmitted to the seat and occupants. Data on several recent accidents of 10-to-19 passenger airplanes operated under part 135 rules indicate that those accidents have occurred at crash conditions approaching those of a flat impact crash. This recent accident data is consistent with the CAMI study, which shows that the majority of commuter category airplane accidents occur at flat-impact conditions. Therefore, the FAA considered it necessary to evaluate the flat-impact crash condition when conducting the analysis leading to the proposals in this notice.

Other airplane performance and design factors were considered during the development of this notice. The FAA evaluated the stall speeds of current production airplanes that are of a design and size similar to airplanes meeting the commuter category rules. Most of those current production airplanes were type certificated to the airworthiness standards of SFAR 41C. The full-flap stall speeds, at airplane maximum takeoff weights, averaged approximately 78 knots for those airplanes. The FAA concluded that those stall speeds generally exceeded the 61-knot stall speed limit for small airplanes that comply with § 23.49, but were similar to stall speeds of larger twin-engine normal category airplanes. The FAA also concluded that the fuselage shell strengths of commuter category airplanes are similar to those of larger normal category twin-engine airplanes.

This proposal includes dynamic test requirements for seat/restraint systems in commuter category airplanes that specify velocity changes similar to those already adopted for dynamic test requirements of seat/restraint systems in normal, utility, and acrobatic category airplanes by considering the similarities in stall speeds and fuselage shell strengths.

Since a shoulder harness is required for each seat/restraint system in current production airplanes that are certificated in either the normal, utility, or acrobatic category, the FAA considered proposing shoulder harness installation requirements for all seats in commuter category airplanes. The FAA concluded that, except for front seats, specific shoulder harness requirements need not be mandated for commuter category airplanes, since compliance with the proposed dynamic test requirements, including the head injury criteria, will eliminate the need for upper torso restraint.

To ensure that adequate occupant protection provisions are provided by the seat/restraint systems in commuter category airplanes, without adding specific requirements for shoulder harness installations, the FAA is proposing that the dynamic tests of commuter category airplane seats be conducted using two rows of seats with each seat occupied by an anthropomorphic test dummy (ATD). In addition to the compliance criteria required for normal, utility, and acrobatic category airplane seat restraint systems, this notice proposes a higher peak deceleration for commuter category airplanes than is presently required by § 23.562(b)(1) and adds limits to the femur loads measured during the dynamic seat tests, making them the same as those limits for transport category airplane seats. Since post-crash evacuation is an essential aspect of cabin safety in commuter category airplanes, this notice also proposes a dynamic test requirement comparable to standards adopted for transport category airplane seats, in which the seat/restraint systems must not yield in a manner that would impede rapid evacuation of the airplane.

The occupant crash protection provided by side-facing seats is a primary concern of the FAA. During the technical analysis leading to this notice, the FAA reviewed the current design techniques for side-facing seat/restraint systems and the occupant protection provided by those configurations. Data on the performance of side-facing seat/restraint systems during crash impact conditions have been documented by CAMI. The data indicate that current side-facing seat designs do not provide the necessary restraint to protect the occupants from serious injury due to impact conditions such as those represented by the dynamic test conditions proposed in this notice. Because side-facing seats, in general, provide very little restraint of an occupant's upper torso, legs, or lower torso, lateral motion may result in serious injury from bending and torsional loading of the occupant's spinal column during relatively minor crash conditions. Developing a side-facing seat/restraint system that provides the occupant protection intended by the dynamic test criteria proposed in this notice has not been shown to be technically or economically feasible at this time. Therefore, this notice proposes rules that would restrict the seat/restraint systems of commuter category airplanes to either forward-facing or aft-facing seat configurations.

A number of current production airplane designs were type certificated to the airworthiness standards of SFAR 41. The anticipated operations of commuter category airplanes are not expected to be significantly different from the operating history of airplanes type certificated to the requirements of SFAR 41. Therefore, the FAA used the operating and accident histories of the SFAR 41 airplanes from NTSB data to establish the occupant protection needs of commuter category airplanes. The CAMI cabin safety research and analyses, which supported the dynamic test requirements applicable to seat/restraint systems of normal category and transport category airplanes, provided technical information regarding current crashworthiness design practices that may be used to assess the performance of commuter category airplane seat/restraint systems. Accident histories, crashworthiness design practices, and an analysis of airframe size effects were used to develop the proposals in this notice. The rules proposed would significantly improve the occupant protection provided by the seat/restraint systems in commuter category airplanes and would enhance the overall safety of those airplanes commensurate with that provided by the recently adopted seat/restraint system requirements for transport category and normal, utility, and acrobatic category airplanes.

As part of the analyses leading to the proposed dynamic test requirements for commuter category airplane seat/restraint systems, the FAA evaluated the need to upgrade other cabin safety regulations in part 23. The FAA concluded that the requirements of § 23.561(b)(3), which concern the static retention strength for items of mass within the cabin, are not compatible with the dynamic loading conditions proposed in this notice, or with the dynamic loading conditions already adopted for seat/restraint systems of normal, utility, or acrobatic category airplanes. During any impact, down-load retention strength may be critical in protecting occupants from serious injury caused by items of mass located in overhead compartments or attached to the overhead structure. Therefore, this notice proposes new downward load factor requirements in § 23.561(b)(3) that would be applicable to items of mass in the cabin of any category of airplane certificated under part 23.

As required by Executive Order 12291, the seat requirements proposed in this notice must be analyzed for the societal costs and benefits that would result from this rulemaking action. GAMA representatives requested a meeting with FAA to discuss the costs and the reasoning for the seat loads in the proposal. The meeting was held on August 18–19, 1988. Although the reasons the FAA provided for the vertical loads in this proposal were accepted at that meeting, a question remained regarding the ability to design a commuter-type seat that would meet this proposed requirement. To resolve this design question, it was agreed that certain seats provided by airframe manufacturers would be tested at CAMI. While the seats originally provided did not meet the proposed requirements, CAMI made minor modifications to one of the seats and it passed the test, thereby demonstrating the practicability of designing seats that can meet this proposed requirement.

A second meeting was held with GAMA on August 22, 1989, to discuss the seat test result. By this testing program, the FAA has been able to demonstrate the feasibility of designing seats that will meet the vertical loads as originally proposed, and no changes were made to this proposal. Records of the August 18–19, 1988, and the August 22, 1989 meetings have been placed in the docket for this project.

Flammability Standards

In addition to proposing occupant protection requirements for dynamic testing of seats, the FAA is proposing new fire safety requirements for passenger seat cushions used in Part 23 commuter category airplanes. These proposed requirements are commensurate with the corresponding requirements for seat cushions used in transport category airplanes.

As a result of regulatory amendment 25–32 (37 FR 3964, February 24, 1972), aircraft seat cushions on transport category aircraft typically are constructed of fire-retardant polyurethane foam and upholstery covering, all of which must presently pass the burn test prescribed in Appendix F of Part 25. In a prolonged full-scale cabin fire condition, however, severe thermal radiation can break down the outer upholstery covering and penetrate into the relatively large fuel mass of the polyurethane foam core. This causes the core to become involved in the fire, spreading flame and producing potentially lethal smoke, combustible gases, and toxic gases. The results of accident investigations and experimental fire tests conducted by the FAA have demonstrated that this involvement of foam cushion material is a dominant factor in the spread of cabin fire. To counter this, fire-retardant performance standards for seat cushions, based on the level of protection that can be achieved by the fire-blocking layer concept, were adopted in amendments 25–59, 29–23, and 121–184.

The fire-blocking layer concept involves the use of a thin layer of highly fire-resistant material, to completely encapsulate and protect the larger mass of foam core seat cushion material from involvement in the cabin fire. This layer of fire-resistant material delays the onset of ignition and retards the involvement of the core in the fire.

The initial phase of the FAA research program for fire-blocking layers consisted of a series of instrument-controlled environment cabin fire tests that confirmed the efficacy and practicality of fire-blocking layers for aircraft seat cushions.

The subsequent phase of the program developed the test for evaluation and certification of cushions, using an adaptation of the type of 2 gallon/hour kerosene burner that is currently in standard use throughout industry as a test for metallic tubing assemblies and components. This test subjects the cushion test specimen to temperature and heat typical of full-scale cabin fire.

Amendments 25–59, 29–23, and 121–184 (49 FR 43188, October 26, 1984) adopted the implementation of detailed procedures of the kerosene burner test developed by the FAA for transport category airplanes. The test subjects seat bottom and seat back cushion specimens to a 2 minute burner flame impingement. The criteria for acceptance are based, in part, on the percentage weight loss of the cushion specimen during the test. While the amendments were based on the performance attained by fire-blocking construction, they do not require that seats cushions be constructed in that way. Rather, they specify objective standards of performance for seat cushions so that, if other or improved means of accomplishing the fire safety objective are developed, they can be used without the need for regulatory amendment. The amendments incorporated the new cushion flammability requirements as additions to the type certification standards for both transport category airplanes and transport category rotorcraft since the flammability requirements for these two categories of aircraft are identical. The amendments also required that, 3 years from the effective date of the final regulation, seat cushions in airplanes type certificated after January 1, 1958, and operated under part 121, meet the new requirements.

Section 23.561

Section 23.561(b)(3) states three orthogonal load factors that define the ultimate static load requirements for the attachment of items of mass in the airplane cabin that could seriously injure occupants during an emergency landing. Those ultimate static load conditions, along with other cabin safety requirements, were added to part 23 by amendment 23–36 to ensure that the attachments of items of mass in the cabin would have adequate retention strength so that they would not pose a hazard to occupants as a result of a minor crash impact. Items of mass are, in general, not located in overhead positions in small airplanes; so, at the time the requirements in § 23.561(b)(3) were adopted, the major concern was to ensure adequate restraint for items of mass that would be located behind the occupants in the cabin. For those items, the forward and side load conditions were considered most critical, so an 18.0 g forward load factor and a 4.5 g sideward load factor were adopted. A 3.0 g upward load factor was also adopted to ensure retention strength from rebound loads.

The adoption of the commuter category airplane airworthiness standards with amendment 23–34 and the technical analysis done to support the dynamic test criteria proposed in this notice for seat/restraint systems of commuter category airplanes have resulted in new concerns for adequate retention of items of mass for downward inertia loads resulting from crash impacts. Since this concern is appropriate for airplanes certificated in all categories, this notice proposes to add a downward inertia load requirement for retention of items of mass in the cabin that pose a hazard to occupants. The intent of the proposed changes to § 23.561(b)(3) is to ensure static retention strength capability that is compatible with the load factors measured during full-scale airframe impact tests. This notice also proposes to modify the introductory text of § 23.561(b)(3) slightly for clarity.

Section 23.562

The present commuter category airplane airworthiness standards provide less occupant protection in an emergency landing than the cabin safety requirements recently adopted for transport category and normal category airplanes. Specific ultimate static inertia load factors related to a minor crash landing are stated in present § 23.561(b)(2). Amendment 23–36 added requirements for dynamic testing of seat/restraint systems in normal, utility, and acrobatic category airplanes. These requirements were stated in a new § 23.562. Dynamic test requirements for seat/restraint systems in commuter category airplanes were not adopted with amendment 23–36 because part 23 did not provide airworthiness requirements for commuter category airplanes when the requirements of § 23.562 where originally proposed.

Since part 23 now provides airworthiness requirements for the type certification of commuter category airplanes, this notice proposes substantial changes to § 23.562 to incorporate regulations for dynamic test evaluations of the seat/restraint systems installed in those airplanes. This notice does not propose any changes to the current dynamic test requirements for seat/restraint systems used in normal, utility, or acrobatic category airplanes.

This proposal would move the compliance criteria of § 23.562(c) to a new paragraph (d) in § 23.562 and move the requirements in § 23.562(d) to a new paragraph (e) in § 23.562. Two additional compliance requirements are proposed for the seat/restraint systems of commuter category airplanes in order to ensure a level of safety that is commensurate with that provided by transport category airplanes. One requirement would limit the axially compressive loads measured in each femur of the ATD to a value of 2,250 pounds. Femur load limits are proposed to ensure occupant protection from injurious compressive loads applied to the upper legs of occupants during the impact conditions prescribed in proposed § 23.562(c). The second new requirement, proposed by this notice, would limit the deflection of the seats, under the dynamic conditions of § 23.562(c), so those seats do not impede rapid evacuation of the airplane by its occupants. Requirements similar to those proposed in this notice were adopted, with amendment 25–64, for dynamic test standards of seats and restraint systems for transport category airplanes.

This proposal would also add a new paragraph § 23.562(c) that would specify the dynamic test conditions for evaluating commuter category airplane seat/restraint systems. The requirements for impact test conditions of proposed § 23.562(c)(1) are significantly different than the predominantly vertical test conditions prescribed in § 23.562(b)(1) for normal, utility, and acrobatic category airplane seats. Analysis of full-scale airframe test data shows that a flat-impact crash results in the most severe dynamic test conditions for a given impact velocity. Data, which are consistent with the CAMI study, indicate that, in accidents of commuter-sized airplanes that complied with SFAR 41 airworthiness standards, the airplanes contacted the ground in a nearly flat-impact crash condition. There were survivors in these accidents, and the fuselage structures maintained a survivable volume in most cases; but, in some cases, the seat/restraint systems did not provide adequate restraint to protect the occupants from serious injuries. The FAA recognizes that the test conditions in proposed § 23.562(c)(1) would be upgraded from those adopted in § 23.562(b)(1). The FAA considers the proposed requirements necessary to ensure a level of cabin safety for commuter category airplanes that is commensurate with that provided by transport category cabin safety standards, which were based on flat-impact crash conditions.

Comments to this notice are invited that address the development of dynamic test parameters that were based on the analysis of assumed flat-impact crash conditions. The comments should include historical data, accident data, analytical studies, or test data, that support the parameter values of proposed § 23.562(c)(1) or other criteria that should be proposed for the substantiation of the level of occupant protection provided by commuter category airplane seat/restraint systems.

Section 23.785

The FAA is proposing changes to those paragraphs of § 23.785 that state requirements for seat/restraint systems and the cabin area surrounding the seats of commuter category airplanes. These changes are necessary so that § 23.785 refers to the proposed dynamic seat test requirements for commuter category airplanes, when applicable. This notice proposes to add dynamic test requirements for the seat/restraint systems of commuter category airplanes to § 23.562(c).

Proposed § 23.785(c) cites the specific requirements for seat/restraint systems of commuter category airplanes. The proposed requirements would limit the seats in commuter category airplanes to either forward-facing or aft-facing designs. The proposal would require that a seat/restraint system for installation in the front row of a commuter category airplane consist of a seat, safety belt, and shoulder harness. The proposed rule would not specifically require shoulder harnesses for seat/restraint systems for installation at other than the front row of those airplanes, but would require that all seat/restraint systems for use in commuter category airplanes comply with the dynamic test requirements and performance criteria being proposed in § 23.562 (c) and (d).

Paragraph (i) of § 23.785 proposes requirements to protect occupants from serious injury due to impact with surrounding structure, and references the occupant protection provisions, as defined for normal, utility, and acrobatic category airplanes, in § 23.562(b), and as proposed for commuter category airplanes in § 23.562(c).

The intent of these proposed changes is to ensure that the dynamic test requirements for seat/restraint systems of commuter category airplanes are referenced in § 23.785, and to limit seat/restraint systems intended for use in commuter category airplanes to forward-facing or aft-facing configurations. The FAA has carefully considered current design practices for side-facing seats and the occupant protection provisions proposed in this notice and has concluded that the available technical information does not demonstrate that the occupant protection requirements proposed in this notice would ensure that side-facing seat configurations could provide the minimum level of occupant protection necessary for those seat/restraint systems installed in commuter category airplanes.

Appendix F

This revision clarifies the vertical test configuration and adds a test configuration for the horizontal test prescribed by paragraph (e). This configuration had been inadvertently omitted.

Under this proposal, seat cushions would be required to meet the new flammability requirements. The proposed criteria for acceptance are based, in part, on the percentage of weight loss of the cushion during the test. Weight loss is a direct measure of the involvement of the material in the fire and a relevant indication of the merit of the cushion for both fire-blocked and non-fire-blocked construction. The criteria proposed would limit the average weight loss of all specimens test to 10%. From the study of various experimental cushions, a 10% limit would represent a major advance in fire safety. It would allow a variety of commercially available foam and fire-blocking materials to be used would be adequate for design and would be optimal from a standpoint of weight and costs. While the proposal is based on the performance attained by cushions constructed with fire-blocking layers, it would not require that all seat cushions be constructed in that way. Rather, the proposal would set objective standards of performance for seat cushions.

Paperwork Reduction Act

The reporting and recordkeeping requirement associated with this rule is being submitted to the Office of Management and Budget for approval in accordance with 44 U.S.C. Chapter 35 under Administration: FAA; Title: Airworthiness Standards; Occupant Protection Standards for Commuter Category Airplanes; Need for Information: The information is needed to check for compliance of seat flammability; Proposed Use of Information: The information collected will be a record of the test results on seat cushion flammability. The tests will be performed by manufacturers of seat cushions and will become a part of the type certification basis for the airplane; Frequency: On occasion; Burden Estimate: 2.5 hours annually; Respondents: Businesses/Manufacturers of aircraft and airplane seats; Forms(s): None; Average Burden Hours Per Response: 30 minutes per response. For further information contact: The Information Requirements Division, M-34, Office of the Secretary of Transportation, 400 Seventh Street, SW., Washington, DC 20590, (202) 366-4735 or Edward Clarke or Wayne Brough, Office of Management and Budget, New Executive Office Building, room 3228, Washington, DC 20503, (202) 395-7340.

Regulatory Evaluation Summary

The FAA has determined that this rulemaking is not "major" as defined by Executive Order 12291. Therefore, no Regulatory Impact Analysis is required. Nevertheless, in accordance with Department of Transportation policies and procedures, the FAA has evaluated the anticipated costs and benefits. Those costs and benefits are summarized below. For more detailed economic information, see the full regulatory evaluation contained in the docket.

Benefits

Seat/Restraint System

The present value of the benefits of the proposed seat/restraint system are estimated to be $1,500 per passenger seat and $3,200 per crew seat. These estimated benefits are based upon a review of the NTSB data on survivable accidents involving commuter type airplanes between 1979 and 1988 in which one or more occupants were either seriously injured or killed. These accidents were severe enough that improved seat/restraint systems could have reduced the number of fatalities and serious injuries.

In the ten-year period covered in the NTSB review, 250 passengers were involved in the 49 survivable commuter airplane accidents considered in this regulatory evaluation. In these accidents, 34 passengers received fatal injuries, 84 passengers received serious injuries, and 132 passengers received minor injuries or no injuries. If these commuter airplanes had been equipped with the improved seat/restraint systems as proposed in this notice, these casualties could have been reduced to 23 fatalities and 31 serious injuries. The reduction in fatalities and serious injuries would increase minor/no injuries to 196.

In order to provide the public and government officials with a benchmark comparison of the expected safety benefits of rulemaking actions over an extended period of time with estimated costs in dollars, the FAA currently uses a value of $2.5 million to statistically represent a human fatality avoided. (This is in accordance with guidelines issued by the Office of the Secretary of Transportation). The FAA has also estimated the societal costs for serious injuries ($640,000) and for minor injuries ($2,300).

The estimated benefits for the reduction in passenger casualties can be calculated by using the above critical values. While the reduction in fatalities and serious injuries is considered a benefit, the increase in minor/no injuries should be deducted from the benefits of these proposed provisions. The net benefit from reduced fatalities and serious injuries as a result of the provision to improve the passenger seat/restraint system is estimated to be approximately $61.3 million between 1979 and 1988. For comparability with other benefits and costs of this proposal, this $61.3 million benefit is converted to a benefit per seat.

In order to convert total benefits into per seat benefits, $61.3 million is first transformed into a benefit estimate per enplanement. There were 222.8 million commuter enplanements between 1979 and 1988. Dividing the estimated benefit for this time period, $61.3 million, by the number of enplanements provides the estimated benefit per enplanement, which is 27.5 cents. The benefits per enplanement can then be converted into annual benefits per passenger seat. The average annual number of enplanements per passenger seat is 847. Thus, the annual benefits per passenger seat are estimated to be $230 (.275×847).

The annual benefits per crew seat is calculated differently than benefits per passenger seat because a crew seat is always occupied on every flight. Thus, there is a greater chance of a crewmember being in a crash and subsequently a greater benefit derived from an improved seat/restraint system. Benefits per crew seat are also more difficult to calculate as directly as those for passenger seats due to data limitations. However, benefits per crew seat can be estimated by dividing the benefits per passenger seat by the average passenger load factor for commuter airplanes. The FAA estimates this load factor to be 46.6 percent and, therefore, the annual benefits per crew seat to be $500 (230/.466).

Assuming each seat/restraint system is used for 15 years, the present value of the above stream of annual benefits can be calculated by discounting each annual benefit by 7 percent for each year in the future. This yields approximately $2,100 per passenger seat and $4,600 per crew seat.

Flammability Standards

In order to estimate the benefits of the proposed flammability standards, the FAA estimated the number of fatalities and serious injuries that could be avoided if there was no post crash fire. One way to arrive at an estimate would be to assume that if the fire could have been avoided, the casualty rate in those accidents with post crash fires would be the same as the rate in accidents where fire did not occur. This, however, may result in an overestimation of the possible reduction in the casualty rates in accidents involving post crash fires. This is because accidents with post crash fire may be more violent than those without fire. Thus, post crash fire accidents, may result in higher casualty rates, even if the fire could be avoided. However, to the extent that casualty rates are higher for survivable accidents (except for the post crash fire), then the potential benefits of the proposed seat/restraint system have been underestimated (assuming the seat/restraint system is effective at reducing the casualty rate in survivable accidents). The FAA is unable to reasonably quantify either the overestimation or the underestimation of these benefits, but it assumes that they offset one another. Thus, the FAA concludes that if the fires could have been prevented, the casualty and injury rates of the 74 passengers involved in commuter airplane crashes with post crash fires between 1979 and 1988 would have been the same as the 176 passengers involved in commuter accidents in which there were no post crash fires. This would mean a reduction of 20 fatalities and 14 serious injuries. Minor/no injuries are assumed to increase by 34 as a result of reduced fatalities and serious injuries and would, therefore, be deducted from the benefits. The total net benefit of the proposed flammability standard is estimated to be $58.9 million. After converting the total net benefit into a net benefit per enplanement (58.9/222.8 millions), multiplying by the annual number of enplanements per seat (847), and discounting at a rate of 7 percent for 15 years, the net discounted benefit per seat of preventing all fatalities and serious injuries is estimated to be $2,000.

Since other factors affect passenger survivability in an aircraft fire, only a portion of these benefits can be attributed to fire-blocking. The FAA has estimated that fire-blocking could be effective in preventing 33 percent of fire fatalities and injuries. Thus, the estimated annual discounted dollar benefits are estimated to be approximately $670 (2,000/3) per seat.

Eliminating Side-Facing Seats

The FAA has determined that current side-facing seat/restraint systems do not provide the necessary restraint to protect the occupants from serious injury. Side-facing seats provide very little restraint of an occupant's upper and lower torso, and legs. Consequently, the sharp lateral motion of an impact may result in serious injury from bending and torsional loading of the occupant's spinal column during relatively minor crash conditions. The benefits from eliminating side-facing airplane seats and replacing them with improved forward-facing or aft-facing seats have not been estimated due to lack of data. However, the present value of the benefits should be greater than the $2,100 estimated for the forward-facing passenger seat/restraint system. This is because side-facing seats are believed to be less safe than forward-facing seats.

Overhead Items of Mass

Items of mass are not now located in overhead positions in general aviation (GA) airplanes. However, in the future there may be items of mass located overhead in larger newly certificated GA airplanes. This provision would prevent any reduction of airplane cabin safety in the event that items of mass are located overhead in newly certificated GA airplanes (be they normal, utility, acrobatic, or commuter airplanes). This provision does not add any quantifiable benefits, but would prevent a reduction in cabin safety if items of mass are ever located overhead in newly certificated airplanes.

This proposed provision is included to ensure that the attachment of items of mass in an overhead position would have adequate retention strength so that they would not pose a hazard to occupants as a result of a survivable crash. In a special study on cabin safety for transport airplanes, the NTSB found that the overhead panels, racks, and passenger-service units failed in 78 percent of the accidents included in the study. Failures of overhead furnishings can cause head injuries and can hamper evacuation of airplanes. A passenger injured by falling items of mass can become confused and slow to react. In the event of a post crash fire, a stunned or unconscious passenger might not be evacuated from the airplane in time to escape serious injury or even death. In the accidents analyzed in the NTSB study, emergency evacuations were often hampered when items stored in the overhead compartments fell into the aisles and against bulkheads adjacent to the exits. Failed overhead furnishings sometimes blocked movement in the cabin by cutting off access to and from aisles and to overwing exits.

Costs

Seat/Restraint System

In this evaluation, it is assumed that for each manufacturer, the design and testing costs of each new seat/restraint system would be incurred during the first year after the compliance date of the proposed rule. It is also assumed that production would last for 15 years. Furthermore, the FAA assumes that these seat/restraint systems would be installed annually in at least 15 airplanes with 15 seats each; thus, 225 seat/restraint systems would be produced and installed each year. The total cost of a manufacturer developing a new seat/restraint system, which includes design, testing, and certification, is estimated to be $161,200. Annualizing the total development cost over 15 years at a 7 percent rate of interest yields approximately $17,700. This annualized development cost, when divided by 225 seats per year, yields development costs of $80 per seat.

After design, testing, and certification, the new seats would then go into production. The FAA estimates that the increased one-time production cost per seat/restraint system would be $60.

Increased operating costs per seat would be the product of the increased weight of the seat/restraint system over the current system in use, the amount of the extra fuel consumed during the year for each extra pound of weight, and the price per gallon of fuel. Each new seat system is estimated to weight 3 pounds more than a current seat system. The FAA estimates that commuter category airplanes burn 15 gallons of fuel each year for each pound of extra weight. The average price of commuter category airplane fuel purchased from a fixed base operator is estimated at $.70 per gallon. The product of the additional weight, fuel consumption, and price of fuel equals the additional operating cost per seat which is $31. Since the seat/restraint system would be used for 15 years, this stream of annual costs was discounted at 7 percent over the 15-year period. The present value of the annual increased operating costs of the proposed seat/restraint systems is approximately $290.

The sum of the annualized development costs ($80), the increased production costs ($60), and the increased discounted operating costs ($290) for each seat/restraint system totals $430.

Improved Flammability Standards

The present value of the costs of the provision establishing new flammability requirements for commuter category airplanes is estimated to be $240 per seat over the next 15 years. This estimated cost is composed of a one-time additional production cost and recurring increased operating cost.

The one-time additional production cost is $80 per seat. This is the average additional production cost estimated by several manufacturers using a variety of fire-blocking materials.

The increased operating cost was estimated much the same way as the seat/restraint system operating cost. The average additional weight of a seat meeting the required flammability standards is estimated to be 1.7 pounds. Commuter category airplanes burn 15 gallons of fuel each year for every pound of extra weight, thus they would burn 26 additional gallons per year. The estimated price of aviation fuel for commuter category aircraft is $.70 per gallon. The product of the additional weight, fuel consumption, and price of fuel yields an additional annual operating cost per seat of approximately $18. Because the new flame retardant seat would be used for 15 years, this stream of annual costs was discounted at 7 percent over the 15-year period. The present value of the increased operating costs of this seat is $160.

There would not necessarily be any development costs as a result of this provision since a variety of commercially available foam and fire-blocking materials could be used that would be adequate for design from a standpoint of weight and costs. Thus, the total present value cost to meet the flammability standards is approximately $240 ($160 plus $80) per seat.

Eliminating Side-Facing Seats

Eliminating side-facing seats would not impose any additional costs on the development or manufacture of new commuter category airplanes; nor would eliminating side-facing seats impose any additional costs on producing these airplanes. Side-facing seats are regular airplane seats placed sideways in the airplane; thus, repositioning side-facing seats to a forward or aft position would not increase installation or operating costs in newly certificated or newly manufactured airplanes. Therefore, this provision of the proposal would not impose any costs on the manufacturers or operators of these airplanes while in operation.

Overhead Items Of Mass

Currently, items of mass are not located overhead in GA airplanes due to the lack of cabin space. If this continues to be the case, this provision of the proposed rule would not be applicable and would not impose any costs on the manufacturers of newly certificated or newly manufactured airplanes, or on the operators of those airplanes when in operation. This provision would be applicable only under the following conditions:

- A new GA airplane is designed with enough cabin space and accommodations to locate items of mass overhead.
- Items of mass are placed in an overhead position inside that airplane.

If both of the above conditions are met, then costs could be incurred as a result of this proposal. If overhead items of mass are not securely contained to withstand the loads imposed in a survivable crash, the occupants of the airplane would bear the costs in terms of reduced cabin safety. In order to avoid the costs of reduced cabin safety, additional costs of designing, testing, manufacturing, and operating would have to be incurred in order to contain the overhead items of mass to withstand the loads imposed in a survivable crash.

If a manufacturer should decide to position compartments overhead for items of mass, there would be the usual development and manufacturing costs associated with installing the compartments. However, the provision of the proposed rule requiring a minimum retention strength of overhead compartments could impose additional costs on the development and manufacturing of these new airplanes. The additional development costs per airplane design are estimated to be $68,200 for designing and $45,100 for testing. The total then is $113,200 per new airplane design or approximately $12,400 annualized cost over 15 years. If it is assumed that 15 airplanes would be produced each year, then the annual discounted design cost per airplane is $830 (12,400/15). This potential cost is then divided by the number of seats per aircraft (which is assumed to be 15) so that it can be compared to other potential costs of the other provisions of the proposed rule. This makes the annual discounted development cost per seat to be $60 (rounded from $55). The costs of operating these new airplanes would not increase significantly as a result of this provision. Overhead compartments for items of mass could be made more secure by using more rivets. The weight of the extra rivets would be negligible and would impose no weight penalty costs of operating these airplanes.

The manufacturer and the operator would have to decide if the benefits from locating items of mass overhead is worth the extra cost of properly securing them. If it is not worth the extra cost, items could be located in other storage areas, thereby, allowing the manufacturer to avoid the extra cost of complying with this provision.

Benefit-Cost Comparison

This section of the evaluation presents a benefit-cost comparison, summarizing the total potential costs and benefits of the four proposed provisions that are expected to accrue over the next 15 years.

The total cost estimate of the four provisions would be approximately $660 to $720 per seat. This cost estimate includes $420 for the seat/restraint system, $240 for improved flammability standards, and possibly $60 to secure overhead items of mass.

The total quantitative benefits of the four provisions of the proposed rule is at a minimum approximately $2,800 per seat. This estimate of total benefits includes the following:

- At least $2,100 per seat for the passenger seat/restraint system. This is a minimum value since the benefits of the crew seat/restraint system would be $4,600 per seat.
- Due to the fact of data, the FAA has not been able to quantify benefits of replacing side-facing seats for forward-facing or aft-facing seats. However, the benefits would be at least $2,100 per seat because side-facing seats are considered to be less safe than forward-facing seats or aft-facing seats. Thus, the potential benefits would be at least that of a new seat/restraint system that is placed in a forward-facing or aft-facing position.
- The benefits of establishing improved flammability standards are established to be $680 per seat.
- The FAA has no data to quantitatively evaluate the reduction in cabin safety due to storing items of mass overhead. Nevertheless, the FAA concludes it is justified in maintaining the current level of safety by requiring that overhead items of mass remain secure in the event of a survivable accident.

The FAA concludes that the proposed rule is cost-beneficial (benefits greater than costs) since total benefits exceed the total costs by approximately $2,100 ($2,800 minus $720) per seat.

International Trade Impact Analysis

The proposed provisions in this notice would have little or no impact on U.S. firms doing business in foreign countries or on foreign firms doing business in the United States. In the United States, foreign manufacturers would have to meet these proposed requirements; thus, foreign firms would gain no competitive advantage from the proposed provisions in this notice. In foreign countries, U.S. firms would not be bound by these part 23 requirements. In foreign countries, these proposed provisions could be selectively implemented by U.S. firms on the basis of competitive considerations.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by government regulations. The RFA requires Federal agencies to review rules that may have "a significant economic impact on a substantial number of small entities."

The FAA's criteria for a small airplane manufacturer is one employing fewer than 75 employees. The criteria for "a substantial number of small entities" is one-third of the small firms subject to the proposed rules, but not fewer than 11 firms. A "significant impact" is one having an annual cost of more than $18,160 per manufacturer. A review of domestic general aviation manufacturers indicates that only six firms meet the size threshold of 75 or fewer employees. Therefore, the proposed amendments to 14 CFR Part 23 would not affect a substantial number of small entities.

Federalism Implications

The regulations proposed herein would not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this proposal would not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

Conclusion

This document proposes to amend the airworthiness standards for commuter category airplanes by upgrading the requirements for seat/restraint systems and by providing new flammability standards for seat cushions. In addition, it proposes to increase the downward inertia load factor for items of mass within the cabin for all part 23 airplanes. For the reasons discussed above, the FAA has determined that this document (1) involves proposed relations that are not major under the provisions of Executive Order 12291, and (2) is significant under DOT Regulatory Policies and Procedures (44 FR 11034, February 26, 1979). In addition the FAA certifies that, under the criteria of the Regulatory Flexibility Act, this proposed rule could not have a significant economic impact, positive or negative, on a substantial number of small entities. In addition, this proposal, if adopted, would have little or no impact on trade opportunities for U.S. firms doing business overseas or for foreign firms doing business in the United States.

List of Subjects in 14 CFR Part 23

Aircraft, Aviation safety, Reporting and recordkeeping requirements, Signs and symbols.

Issued in Washington, DC on June 24, 1993.

Thomas E. McSweeny,

Acting Director, Aircraft Certification Service.

The Proposed Amendment

In consideration of the foregoing, the Federal Aviation Administration proposes to amend part 23 of the Federal Aviation Regulations (14 CFR part 23) as follows:

PART 23—AIRWORTHINESS STANDARDS: NORMAL, UTILITY, ACROBATIC, AND COMMUTER CATEGORY AIRPLANES

1. The authority citation for part 23 is revised to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1425, 1428, 1429, and 1430; 49 U.S.C. 106(g).

2. Paragraph (d) is added and reserved and a new paragraph (e) is added to § 23.2 to read as follows:

§ 23.2 Special retroactive requirements.

* * * * *

(e) Notwithstanding §§ 21.17 and 21.101 of this chapter and irrespective of the type certification basis, each commuter category airplane, including any such foreign manufactured airplane approved for entry into the United States, manufactured after June 16, 1996, must show compliance with §§ 23.562 and 23.853 of this part.

3. Section 23.561 is amended by revising paragraphs (b)(3) introductory text and (b)(3) (ii) and (iii), and by adding paragraph (b)(3)(iv) to read as follows:

§ 23.561 General.

* * * * *

(b) * * *

(3) Each item of mass within the cabin experiences static inertia loads that act separately relative to the surrounding structure and correspond to the following ultimate load factors—

(i) * * *

(ii) Downward, 18.0 g;

(iii) Forward, 18.0 g; and

(iv) Sideward, 4.5 g.

* * * * *

4. Section 23.562 is amended by revising paragraph (a) introductory text, paragraphs (c) and (d), and by adding a new paragraph (e) to read as follows:

§ 23.562 Emergency land dynamic conditions.

(a) Each seat/restraint system must be designed to protect each occupant during an emergency landing when—

* * * * *

(c) Each seat/restraint system, for crew or passenger occupancy in a commuter category airplane, must successfully complete dynamic tests in accordance with each of the following conditions. The tests of the passenger seat/restraint system must be conducted using two rows of seat/restraint systems with each occupant simulated by an anthropomorphic test dummy (ATD) defined by 49 CFR part 572, subpart B, or an FAA-approved equivalent, with a nominal weight of 170 pounds and seated in the normal upright position. A crew seat/restraint system may be tested in a single configuration.

(1) For the first test, the change in velocity may not be less than 31 feet per second. Each seat/restraint system must be oriented in its nominal position with respect to the airplane and with the horizontal plane of the airplane pitched up 60 degrees, with no yaw, relative to the impact vector. The peak deceleration must occur in not more than 0.03 seconds after impact and must reach a minimum of 32 g.

(2) For the second test, the seat structure must be preloaded as defined in paragraph (c)(3) of this section. The change in velocity may not be less than 42 feet per second. Each seat/restraint system must be oriented in its nominal position with respect to the airplane and with the vertical plane of the airplane yawed 10 degrees, with no pitch, relative to the impact vector in the direction that results in the greater loading of the shoulder harness, where installed. The peak deceleration must occur in not more than 0.05 seconds after impact and must reach a minimum of 26 g.

(3) To account for floor warpage, the floor rails or attachment devices used to attach each seat/restraint system to the airframe structure must be preloaded to misalign, with respect to each other, by at least 10 degrees vertically (i.e., pitch out of parallel), and one of the rails or attachment devices must be preloaded to misalign by 10 degrees in roll prior to conducting the test defined by paragraph (c)(2) of this section.

(d) Compliance with the following requirements must be shown during the dynamic tests conducted in accordance with either paragraph (b) or (c) of this section:

(1) The seat/restraint system must restrain the ATD, although the seat/restraint system components may experience deformation, elongation, displacement, or crushing intended as part of the design.

(2) The attachment between the seat/restraint system and the test fixture must remain intact, although the seat structure may have deformed.

(3) When shoulder harnesses are provided as part of the design, each shoulder harness strap must remain on the ATD's shoulder during the impact.

(4) The safety belt must remain on the ATD's pelvis during the impact.

(5) The results of the dynamic test must show that the occupant is protected from serious head injury.

(i) When contact with adjacent seats, structure, or other items in the cabin can occur, protection must be provided so that impact of the head of each occupant does not exceed a Head Injury Criterion (HIC) of 1,000.

(ii) The value of HIC is defined as—

$$HIC = \left\{ (t_2 - t_1) \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t)dt \right]^{2.5} \right\}_{MAX}$$

Where:

t_1 is the initial integration time, expressed in seconds,

t_2 is the final integration time, expressed in seconds,

$(t_2 - t_1)$ is the time duration of the major head impact, expressed in seconds, and

a (t) is the resultant deceleration at the center of gravity of the head form, expressed as a multiple of g (units of gravity).

(iii) Compliance with the HIC limit must be demonstrated by measuring the head impact during the dynamic tests required in either paragraph (b) or paragraph (c) of this section, or by a separate showing of compliance with the HIC using approved test or analysis procedures.

(6) Loads in a single shoulder harness strap may not exceed 1,750 pounds. If dual straps are used for retaining the upper torso, the total strap loads may not exceed 2,000 pounds.

(7) The compression load measured between the pelvis and the lumbar spine of the ATD may not exceed 1,500 pounds.

(8) For commuter category airplanes, where leg injuries may result from contact with seats or other structure during an emergency landing, the axially compressive loads measured in each demur of the ATD may not exceed 2,250 pounds.

(9) For commuter category airplanes, no seat/restraint system may yield in a manner that would impede rapid evacuation of the airplane.

(e) An alternative approach that achieves an equivalent, or greater, level of occupant protection to that required by this section may be used if substantiated on a rational basis.

5. Section 23.785 is amended by revising paragraphs (c) and (i) to read as follows:

§ 23.785 Seats, berths, litters, safety belts, and shoulder harnesses.

* * * * *

(c) Each seat/restraint system in a commuter category airplane must be either forward-facing or aft-facing. Each seat/restraint system intended for installation in the front row of a commuter category airplane must consist of a seat, safety belt, and shoulder harness and must provide the occupant protection provisions required by § 23.562. Each seat/restrain system intended for installation at a position other than the front seats of a commuter category airplane must consist of a seat and safety belt (or a seat, safety belt, and shoulder harness) and must provide the occupant protection required in § 23.562.

* * * * *

(i) The cabin area surrounding each seat, including the structure, interior walls, instrument panel, control wheel, pedals, and seats within striking distance of an occupant's head or torso (with the restraint system fastened) must be free of potentially injurious objects, sharp edges, protuberances, and hard surfaces. If energy absorbing designs or devices, such as padding, are used to meet this requirement, they must also comply with the occupant protection provisions of § 23.562, as required by paragraph (b) or (c) of this section.

* * * * *

6. Section 23.853 is amended by removing the words "Appendix F" and

adding in their place the words "Part I of Appendix F" each time they appear in paragraphs (d)(3)(i), (ii), (iv), and (v) and (f), and by adding paragraph (d)(3)(vi) to read as follows:

§ 23.853 Compartment interiors.

* * * * *

(d) * * *

(3) * * *

(vi) Seat cushions, except those of flight crewmember seats, must meet the requirements of both paragraph (d)(3)(ii) of this section and of Part II of Appendix F of this part, or equivalent.

* * * * *

7. Appendix F to part 23 is amended by revising the heading, by removing the first paragraph, by designating the current text as Part I and adding a heading for Part I, by revising the last sentence of paragraph (b) of newly designated Part I, by adding the words "of Part I" before the words "of this Appendix" wherever they appear in paragraphs (c) and (d) of newly designated Part I, and by adding a new Part II to read as follows:

Appendix F to Part 23—Test Procedures

Part I—An Acceptable Test Procedure for Self-Extinguishing Materials for Showing Compliance with § 23.853

* * * * *

(b) * * * When performing the tests prescribed by paragraphs (d) and (e) of part I of this Appendix, the specimen must be mounted in a metal frame so that: (1) In the vertical test prescribed by paragraph (d) of Part I of this appendix, the two long edges and the upper edge are held securely; (2) in the horizontal test prescribed by paragraph (e) of Part I of this appendix, the two long edges and the edge away from the flame are held securely; (3) the exposed area of the specimen is at least 2 inches wide and 12 inches long, unless the actual size used in the airplane is smaller; and (4) the edge to which the burner flame is applied must not consist of the finished or protected edge of the specimen but must be representative of the actual cross section of the material or part installed in the airplane.

* * * * *

Part II—Flammability of Seat Cushions

(a) *Criteria for Acceptance.* Each seat cushion must meet the following criteria:

(1) At least three sets of seat bottom and seat back cushion specimens must be tested.

(2) If the cushion is constructed with a fire-blocking material, the fire-blocking material must completely enclose the cushion foam core material.

(3) Each specimen tested must be fabricated using the principal components (i.e., foam core, flotation material, fire-blocking material, if used, and dress covering) and assembly processes (representative seams and closures) intended for use in the production articles. If a different material combination is used for the back cushion than for the bottom cushion, both material combinations must be tested as complete specimen sets consisting of a back cushion specimen and a bottom cushion specimen. If a cushion, including the outer dress covering, meets the oil burner test requirements of Part II of this appendix, the dress covering of that cushion may be replaced with a similar dress covering, provided the burn length of the replacement covering, as determined by the test specified in § 23.853(d)(3)(ii), does not exceed the corresponding burn length of the original dress covering.

(4) For at least two-thirds of the total number of specimen sets tested, the burn length from the burner must not reach the side of the cushion opposite the burner. The burn length must not exceed 17 inches. Burn length is the perpendicular distance from the inside edge of the seat frame closest to the burner to the farthest evidence of damage to the test specimen from impinging flames. This includes areas that were partially or completely consumed, charred, or embrittled, but does not include areas that were sooted, stained, warped, or discolored, or areas where material shrank or melted away from the heat source.

(5) The average percentage weight loss must not exceed 10 percent. Also, at least two thirds of all specimen sets tested must not exceed 10 percent weight loss. All droppings falling from the cushions and mounting stand are to be discarded before the after-test weight is determined. The percentage weight loss for a specimen set is the weight of the set before testing less the weight of the set after testing expressed as the percentage of the weight before testing.

(b) *Test Conditions.* Vertical air velocity should average 25 feet per minute (fmp) ±10 fpm at the top of the back of the seat cushion. Horizontal air velocity should be below 10 fpm just above the bottom seat cushion. Air velocities should be measured with the ventilation hood operating and the burner motor off.

(c) *Test Specimens.*

(1) For each test, one set of cushion specimens representing a seat bottom and seat back cushion must be used.

(2) The seat bottom cushion specimen must be 18±1/8 inches (457±3 mm) wide by 20±1/8 inches (508±3 mm) deep by 4±1/8 inches (102±3 mm) thick, exclusive of fabric closures and seam overlap.

(3) The seat back cushion specimen must be 18±1/8 inches (457±3 mm) wide by 25±1/8 inches (635±3 mm) high by 2±1/8 inches (51±3 mm) thick, exclusive of fabric closures and seam overlap.

(4) The specimens must be conditioned at 70±5 °F *21±2 °C) and 55±10% relative humidity for at least 24 hours before testing.

(d) *Test Apparatus.* The arrangement of the test apparatus is shown in Figures 1 through 5 of Part II of this appendix and must include the components described in this section. Minor details of the apparatus may vary, depending on the model burner used.

(1) *Specimen Mounting Stand.* The mounting stand for the test specimens consists of steel angles, as shown in Figure 1 of part II of this appendix. The length of the mounting stand legs is 12±1/8 inches (305±3 mm). The mounting stand must be used for mounting the test specimen seat bottom and seat back, as shown in Figure 2 of Part II of this appendix. The mounting stand should also include a suitable drip pan lined with aluminum foil, dull side up.

(2) *Test Burner.* The burner to be used in testing must—

(i) Be a modified gun type;

(ii) Have an 80-degree spray angle nozzle nominally rated for 2.25 gallons/hour at 100 psi;

(iii) Have a 12-inch (305 mm) burner cone installed at the end of the draft tube, with an opening 6 inches (152 mm) high and 11 inches (280 mm) wide, as shown in Figure 3 of Part II of this appendix; and

(iv) Have a burner fuel pressure regulator that is adjusted to deliver a nominal 2.0 gallon/hour of No. 2 grade kerosene or equivalent required for the test.

Note: Burner models that have been used successfully in testing are the Lennox Model OB–32, Carlin Model 200CRD, and Park Model DPL 3400. FAA published reports pertinent to this type of burner are: (1) Powerplant Engineering Report No. 3A, Standard Fire Test Apparatus and Procedure for Flexible Hose Assemblies, dated March 1978; and (2) Report No. DOT/FAA/RD/76/713, Reevaluation of Burner Characteristics for Fire Resistance Tests, dated January 1977.

(3) *Calorimeter.*

(i) The calorimeter to be used in testing must be a 1–15.0 BTU/ft²-sec. (0–17.0 w/cm²) calorimeter, accurate ±3%, mounted in a 6-inch by 12-inch (152 by 305 mm) by 3/4-inch (19 mm) thick calcium silicate insulating board that is attached to a steel angle bracket for placement in the test stand during burner calibration, as shown in Figure 4 of Part II of this appendix.

(ii) Because the insulating board could crumble with service and result in misalignment of the calorimeter, the calorimeter must be monitored and the mounting shimmed, as necessary, to ensure that the calorimeter face is flush with the exposed plane of the insulating board in a plane parallel to the exit of the test burner cone.

(4) *Thermocouples.* The thermocouples to be used for testing must be 1/16 to 1/8 inch metal sheathed, ceramic packed, type K, grounded thermocouples with a nominal 22 to 30 American wire gage (AWG) size conductor.

The thermocouples must be attached to a steel angle bracket to form a thermocouple rake for placement in the test stand during burner calibration, as shown in Figure 5 of Part II of this appendix.

(5) *Apparatus Arrangement.* The test burner must be mounted on a suitable stand to position the exit of the burner cone a distance of 4±1/8 inches (102±3 mm) from one side of the specimen mounting stand. The burner stand should have the capability of allowing the burner to be swung away from the specimen mounting stand during warmup periods.

(6) *Data Recording.* A recording potentiometer or other suitable calibrated instrument with an appropriate range must be used to measure and record the outputs of the calorimeter and the thermocouples.

(7) *Weight Scale.* A weighing device must be used that, with proper procedures, determines the weights of each set of seat cushion specimens before and after the test within 0.02 pound (9 grams). A continuous weighing system is preferred.

(8) *Timing Device.* A stopwatch or other device (calibrated to ±1 second) must be used to measure the time of application of the burner flame and self-extinguishing time or test duration.

(e) *Preparation of Apparatus.* Before calibration, all equipment must be turned on and the burner fuel must be adjusted as specified in paragraph (d)(2) of Part II of this appendix.

(f) *Calibration.* To ensure the proper thermal output of the burner, the following test must be made:

(1) Place the calorimeter on the test stand as shown in Figure 4 of Part II of this appendix at a distance of 4±⅛ inches (102±3 mm) from the exit of the burner cone.

(2) Turn on the burner, allow it to run for 2 minutes for warmup, and adjust the burner air intake damper to produce a reading of 10.5±0.5 BTU/ft^2 sec. (11.9+0.6 w/ cm^2) on the calorimeter to ensure steady state conditions have been achieved. Turn off the burner.

(3) Replace the calorimeter with the thermocouple rake (Fig. 5 of Part II of this appendix).

(4) Turn on the burner and ensure that the thermocouples are reading 1900±100 °F (1038±38 °C) at steady state conditions.

(5) If the calorimeter and thermocouples do not read within range, repeat steps in paragraphs (f)(1) through (f)(4) of Part II of this appendix and adjust the burner air intake damper until the proper readings are obtained. The thermocouple range and the calorimeter should be used frequently to maintain and record calibrated test parameters. Until the specific apparatus has demonstrated consistency, each test should be calibrated. After consistency has been confirmed, several tests may be conducted with the pre-test calibration before and a calibration check after the series.

(g) *Test Procedure.* The flammability of each set of specimens must be tested as follows:

(1) Record the weight of each set of seat bottom and seat back cushion specimens to be tested to the nearest 0.02 pound (9 grams).

(2) Mount the seat bottom and seat back cushion test specimens on the test stand as shown in Figure 2 of Part II of this appendix, securing the seat back cushion specimen to the test stand at the top.

(3) Swing the burner into position and ensure that the distance from the exit of the burner cone to the side of the seat bottom cushion specimen is 4±⅛ inches (102±3 mm).

(4) Swing the burner away from the test position. Turn on the burner and allow it to run for 2 minutes to provide adequate warmup of the burner cone and flame stabilization.

(5) To begin the test, swing the burner into the test position and simultaneously start the timing device.

(6) Expose the seat bottom cushion specimen to the burner flame for 2 minutes and then turn off the burner. Immediately swing the burner away from the test position. Terminate the test 7 minutes after initiating cushion exposure to the flame by use of a gaseous extinguishing agent (i.e., Halon or CO_2).

(7) Determine the weight of the remains of the seat cushion specimen set left on the mounting stand to the nearest 0.02 pound (9 grams), excluding all droppings.

(h) *Test Report.* With respect to all specimen sets tested for a particular seat cushion for which testing of compliance is performed, the following information must be recorded:

(1) An identification and description of the specimens being tested.

(2) The number of specimen sets tested.

(3) The initial weight and residual weight of each set, the calculated percentage weight loss of each set, and the calculated average percentage weight loss for the total number of sets tested.

(4) The burn length for each set tested.

Figures to Part II of Appendix F to Part 23

BILLING CODE 4910–13–M

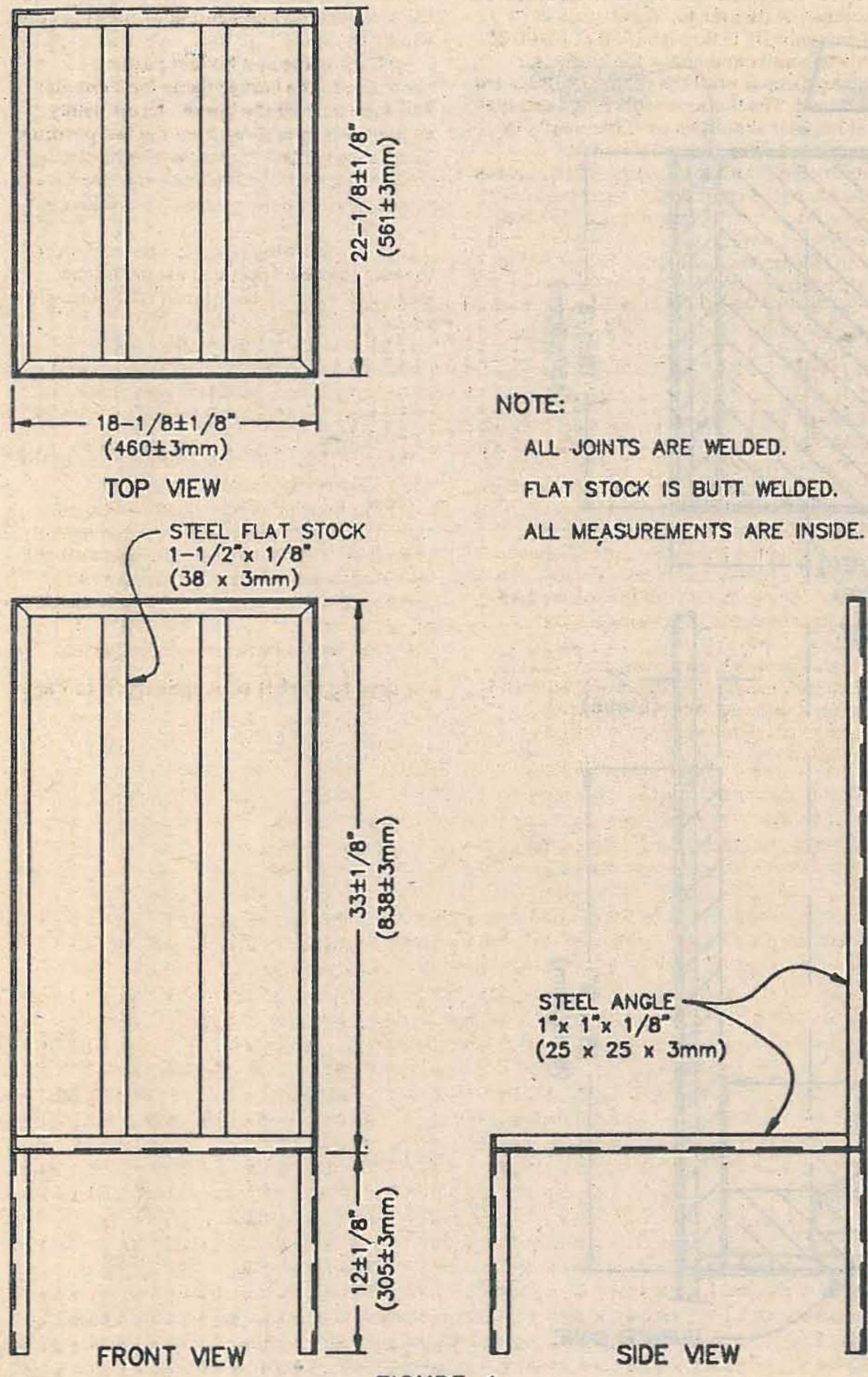
22-1/8±1/8"
(561±3mm)
18-1/8±1/8"
(460±3mm)
TOP VIEW
NOTE:
ALL JOINTS ARE WELDED.
FLAT STOCK IS BUTT WELDED.
ALL MEASUREMENTS ARE INSIDE.
STEEL FLAT STOCK
1-1/2"x 1/8"
(38 x 3mm)
33±1/8"
(838±3mm)
12±1/8"
(305±3mm)
STEEL ANGLE
1"x 1"x 1/8"
(25 x 25 x 3mm)
FRONT VIEW
SIDE VIEW

FIGURE 1.

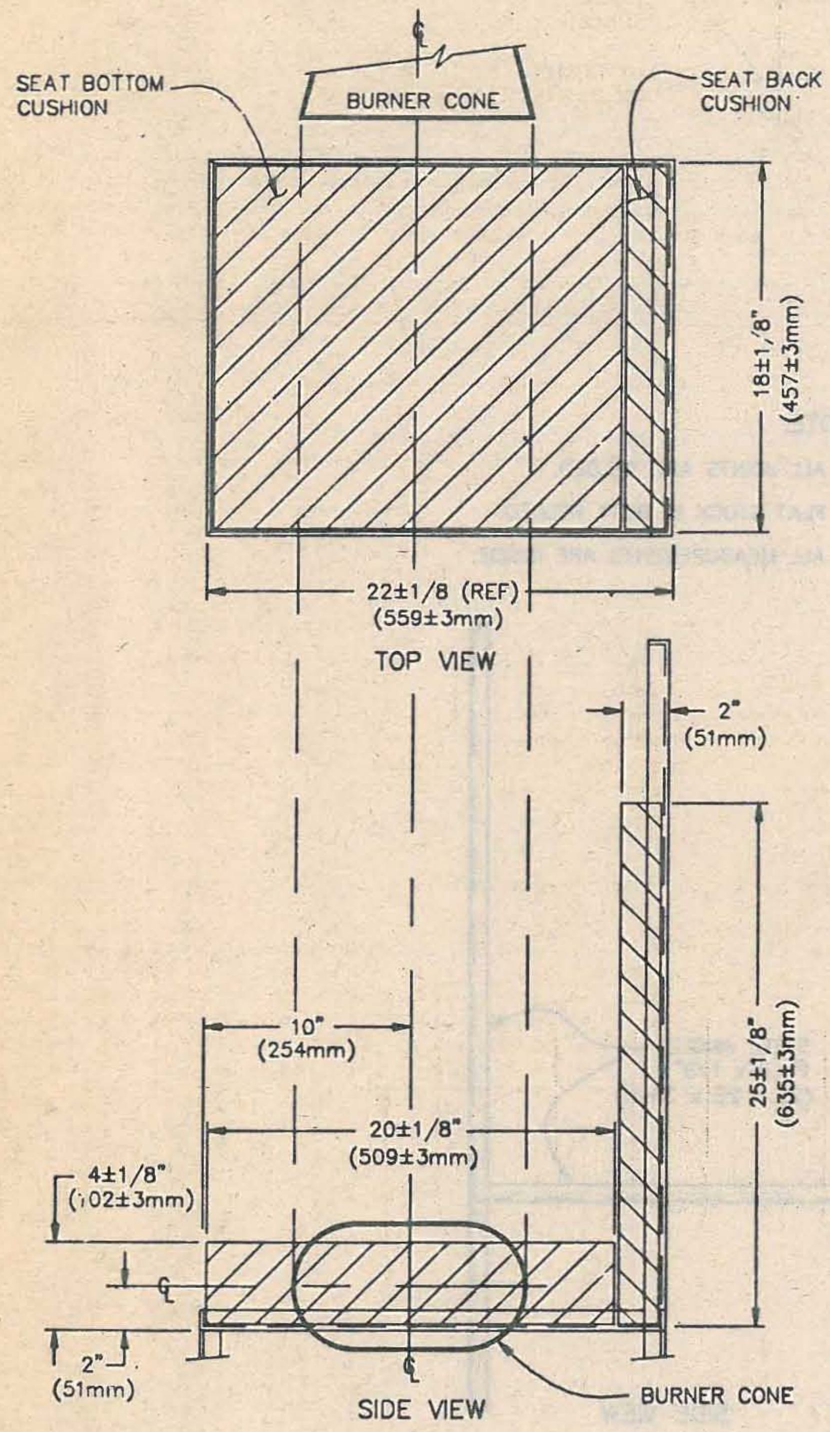
SEAT BOTTOM CUSHION
BURNER CONE
SEAT BACK CUSHION
18±1/8" (457±3mm)
22±1/8 (REF) (559±3mm)
TOP VIEW
2" (51mm)
10" (254mm)
20±1/8" (509±3mm)
4±1/8" (102±3mm)
25±1/8" (635±3mm)
2" (51mm)
SIDE VIEW
BURNER CONE

FIGURE 2.

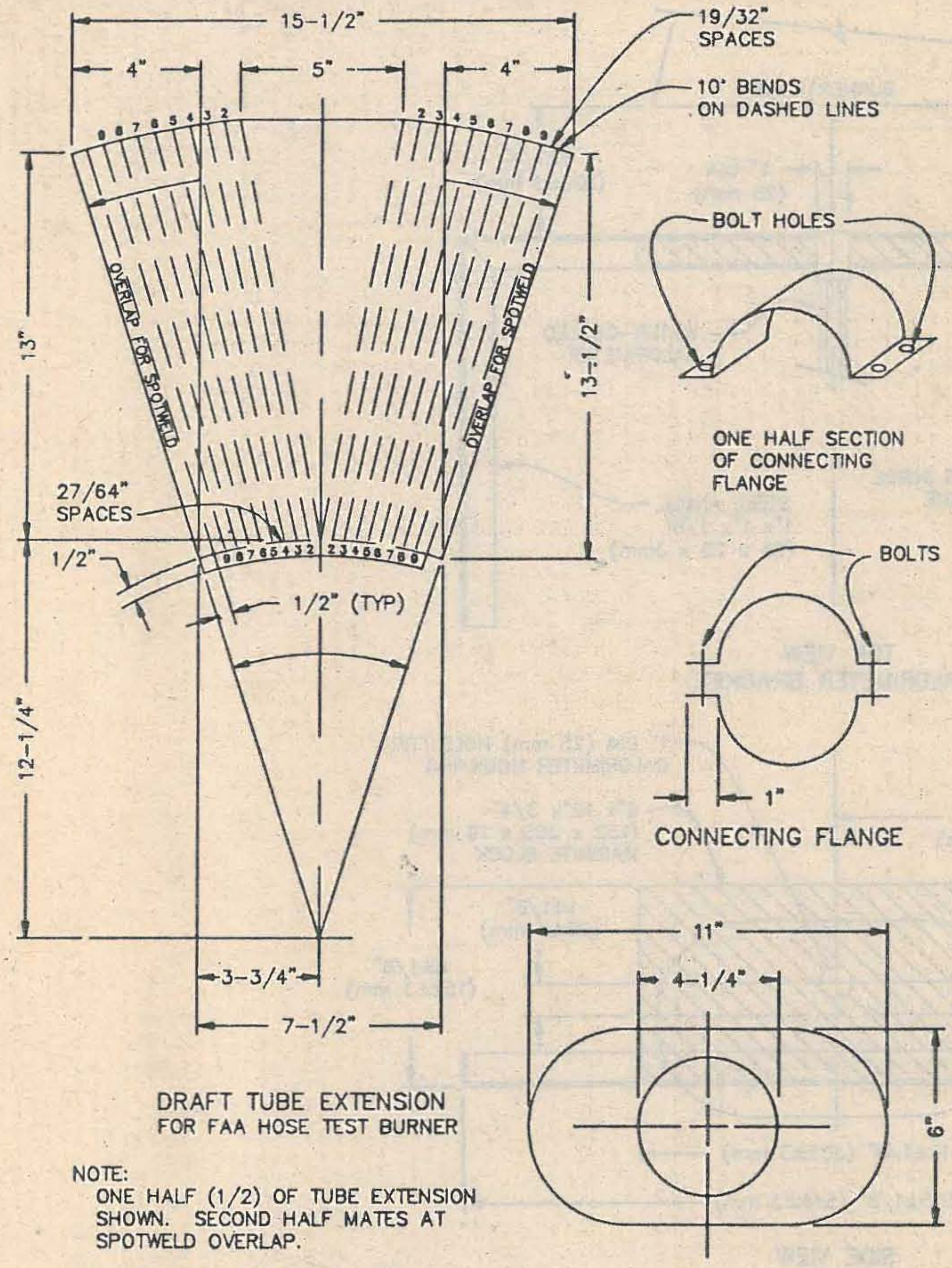
15-1/2"
4"
5"
4"
19/32"
SPACES
10° BENDS
ON DASHED LINES
OVERLAP FOR SPOTWELD
OVERLAP FOR SPOTWELD
13"
13-1/2"
27/64"
SPACES
1/2"
1/2" (TYP)
12-1/4"
3-3/4"
7-1/2"
BOLT HOLES
ONE HALF SECTION
OF CONNECTING
FLANGE
BOLTS
1"
CONNECTING FLANGE
11"
4-1/4"
6"
DRAFT TUBE EXTENSION
FOR FAA HOSE TEST BURNER
NOTE:
ONE HALF (1/2) OF TUBE EXTENSION
SHOWN. SECOND HALF MATES AT
SPOTWELD OVERLAP.
MATERIAL: 0.050 STAINLESS STEEL

FIGURE 3.

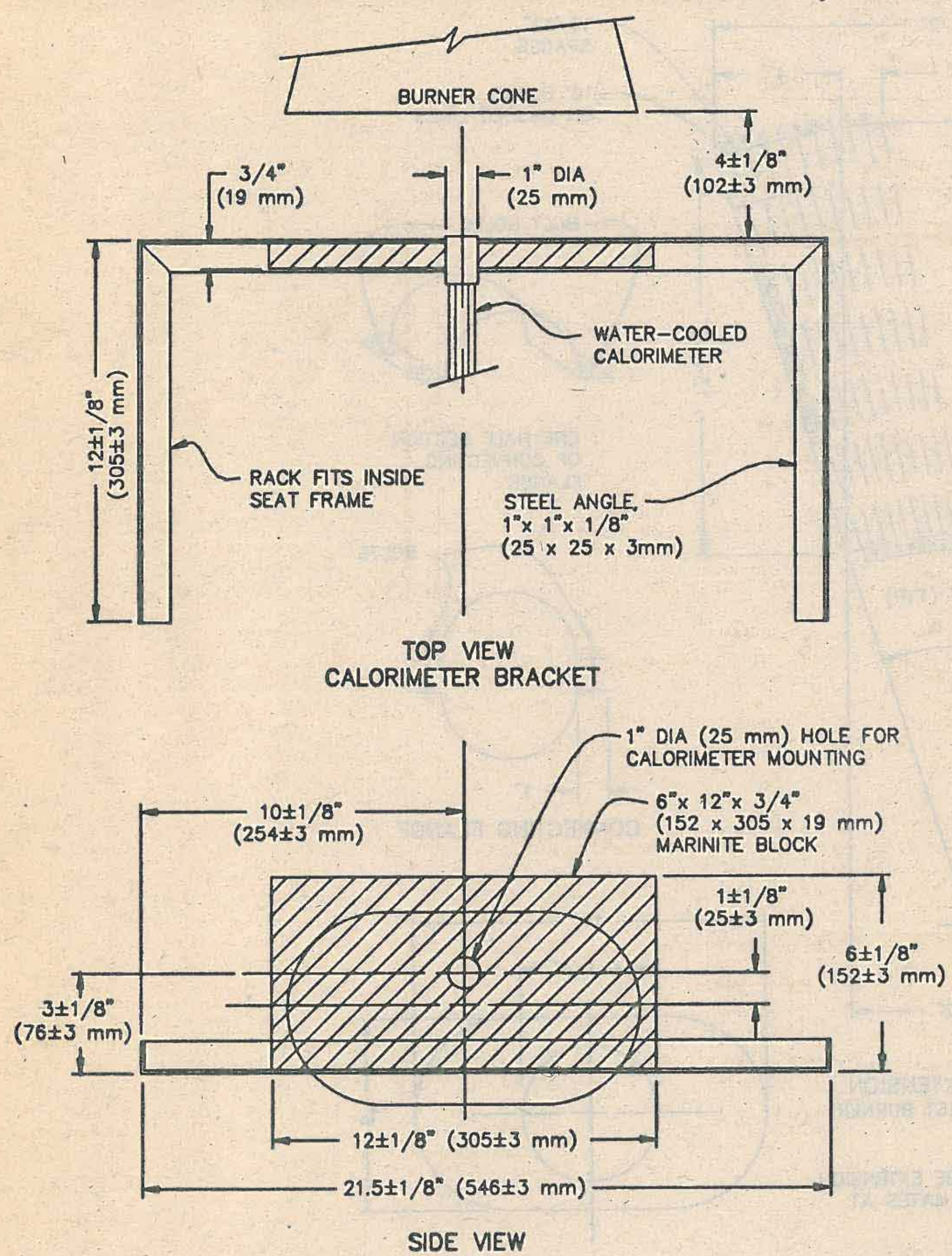
BURNER CONE
3/4" (19 mm)
1" DIA (25 mm)
4±1/8" (102±3 mm)
WATER-COOLED CALORIMETER
12±1/8" (305±3 mm)
RACK FITS INSIDE SEAT FRAME
STEEL ANGLE, 1"x 1"x 1/8" (25 x 25 x 3mm)
TOP VIEW
CALORIMETER BRACKET
1" DIA (25 mm) HOLE FOR CALORIMETER MOUNTING
10±1/8" (254±3 mm)
6"x 12"x 3/4" (152 x 305 x 19 mm) MARINITE BLOCK
1±1/8" (25±3 mm)
6±1/8" (152±3 mm)
3±1/8" (76±3 mm)
12±1/8" (305±3 mm)
21.5±1/8" (546±3 mm)
SIDE VIEW

FIGURE 4.

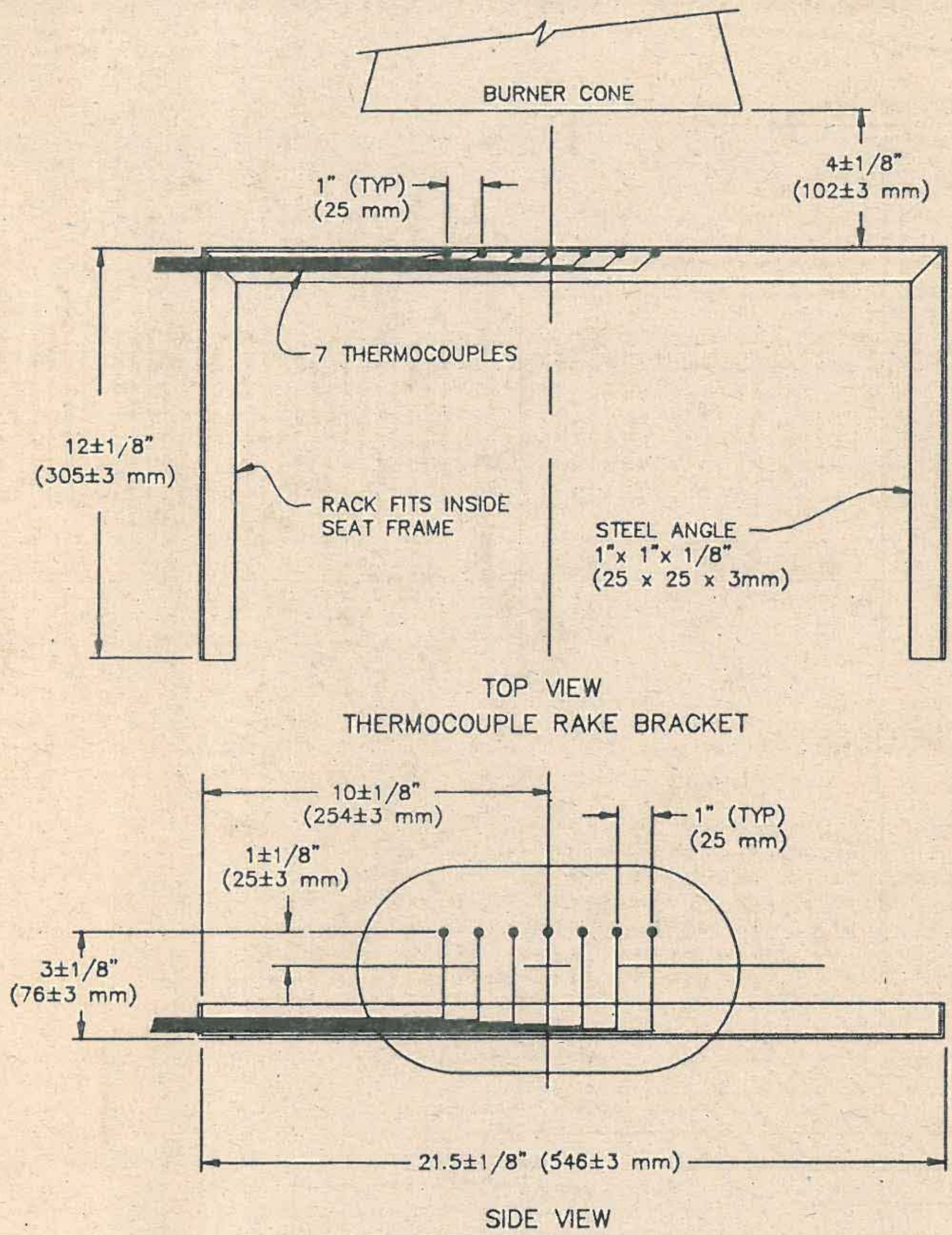

FIGURE 5.

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