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AEROSPACE RECOMMENDED PRACTICE

ARP 750

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ENTIRE PRACTICE REVISED

PASSENGER SEAT DESIGN COMMERCIAL TRANSPORT AIRCRAFT

1. PURPOSE:

The purpose of this aerospace recommended practice (ARP) is to provide design criteria that will lead to seat designs which provide maximum safety for air transportation passengers.

NOTE: It is not the purpose of the ARP to specify design methods or specific designs to be followed in the accomplishment of the stated objectives.

2. INTRODUCTION:

2.1 Definitions (as used in this recommended practice):

2.1.1 Seat Assembly: One complete passenger seat unit, whether for single or multiple passenger occupancy normally removable as a unit from the aircraft. The seat assembly includes the seat structure, cushions, trim panels, armrests, dress covers, ashtrays, etc., and may include various options such as footrests, accessory pockets, tray tables (either attached to the passenger seat or plug-in type), flotation seat cushions or life vest provisions, underseat baggage restraint devices, automatic oxygen systems, passenger service and entertainment units (including multiplexing system components attached to seat), and passenger service cart tethering devices, as applicable. It shall not include passenger seat belts, air sickness containers, literature for passenger use, life jackets, headrest covers (antimacassar), or other loose equipment not normally supplied by aircraft seat manufacturers.

2.1.2 Seat Structure: That which provides the primary structural support and restraint link between the passenger and passenger seat belt and the aircraft fuselage structure under the conditions in 2.2.

2.1.3 Seat Secondary Structure: That which provides the requirements for occupant comfort, seat utility and appearance.

2.1.4 Recline Lock Override: That design feature of a reclinable seat back which permits returning the seat back from any angle of recline to the normal upright position by the mere application of force in the direction of travel to the seat back.

2.1.5 Seat Back Breakover: The design feature that permits folding the seat back forward from the normal upright position by the mere application of force to the seat back.

2.1.6 Seat Design Ultimate Static Load: The highest design static load which the seat is capable of supporting for a minimum of three seconds without a failure which causes loss of restraint function. Design ultimate loads are 1.5 times the design limit loads, and the loading test requirements and test procedures are defined in NAS 809. (NOTE: Gust load conditions for specific aircraft may exceed the upward, downward or side loads specified in NAS 809. These conditions are defined in the specifications of the aircraft manufacturer.)

2.1.7 Passenger Weight: Minimum weight criteria as defined by the current FARs shall be used in developing static and dynamic test loads for the seat.

2.1.8 Standard Luggage Weight: A weight of 20 lb (9.07 kg) per passenger to be used in developing static and dynamic test loads for the seat.

2.1.9 Seat Separation Load: The static or dynamic load required to cause a failure of a nature that will permit detachment of the seat from the aircraft structure.

2.2 Scope: In addition to those aspects of a passenger seat as comfort and appearance, the passenger seat, whether aft, forward or side facing, is the basic link that supports and ties the occupant to the aircraft structure. It is essential that the support and tie down functions be accomplished in a manner that will provide maximum safety during all normal conditions of flight, emergency flight maneuvers and crash landings, whether on land or water, and that these functions are not compromised to attain the comfort and appearance features.

3. RECOMMENDATIONS:

3.1 General Provisions:

3.1.1 The Federal Aviation Regulations and Technical Standards Orders requirements for air transport passenger seats shall be considered as minimum requirements.

3.1.2 The seat structure shall be designed to absorb as much energy as possible after the seat design ultimate load is exceeded and before the seat separation load is reached.

3.1.3 Failure of the seat secondary structure under crash landing conditions shall not affect the strength of the seat basic structure, nor on failing shall it leave projections which could cause incapacitating or fatal injuries or trap the occupants.

3.1.4 In addition to the FAR requirements, the seat assembly separation load requirements and FAR ultimate static load requirements shall be met with the forward load applied anywhere up to 30 degrees to left, right or above the airplane fore and aft axis, and anywhere within 45 degrees below the airplane fore and aft axis under the following conditions:

3.1.4.1 Seat eccentrically loaded due to one or more passenger places not occupied in addition to all passenger places occupied.

3.1.4.2 In addition to the FAR requirements, the seat assembly should be tested with the baggage load specified per 2.1.8 applied concurrently with the test load when the baggage restraint bar is an integral part of the seat assembly.

3.1.5 Seat performance under dynamic loading shall be considered and shall include the following factors:

3.1.5.1 The effect of seat belt tightness and the flexibility of seat occupants when subjected to high dynamic loads of short time duration.

3.1.5.2 The actions of all latches, closure devices, and quick release type mechanisms.

3.1.5.3 In an aft-facing seat, the fact that the seat back may not be in either the full upright or the full recline position.

3.1.6 Loads likely to be applied to the basic structure of one seat (and the deflections caused by the application of the loads) by the occupants of the seat ahead and behind shall be considered in designing for the separation load conditions.

3.1.7 The seat assembly shall be free of sharp edges or projections which could cause damage to the seat belt, snagging of occupants' wearing apparel, or injury to the occupant. This shall apply to all areas of the seat which are exposed to occupants of the same or adjacent seats and with all movable seat components (backs, armrests, food trays, etc.) in all positions. In addition, seat structure which is covered with materials which deform easily (cushions, fabrics, foam pads, etc.) shall be free of sharp edges or projections which could cause injury to occupants under impact. Special consideration shall be given to the seat backs, and exposed structure beneath the seat bottom where head or leg contact is likely. (See ARP 767A.)

3.1.8 The seat assembly shall be suitably protected against corrosion. The design shall avoid trapped areas where spilled liquids can accumulate and cause corrosion.

3.1.9 Materials and finishes shall be selected so as to minimize the generation of toxic gas and smoke during a fire.

3.1.10 The effect of wear shall be considered in designing the seat structure to meet the design load conditions. In the case of aft facing seats, special consideration shall be given to the effect of wear on recline control mechanism and seat back pivot points.

3.1.11 The seat assembly shall be designed and constructed to permit easy removal of any burning materials (cigarette, cigar, etc.) which have dropped down into the seat structure or between the seat and aircraft cabin trim.

3.1.12 Forward facing seats shall be equipped with a seat breakover feature if this will minimize the likelihood of injury to the occupants of the seat behind under the loads imposed by the crash landing conditions. Breakover should not allow any portion of the seat back to encroach on required exit space. Force to actuate breakover shall not be so low as to preclude use of the seat back as rough air support for passengers in the aisles, nor high enough to cause injury to seated passengers or impede egress during emergency conditions. A recommended guideline for breakover force is 30 lb ± 5 (13.61 kg ± 2.27) applied to the top of the seat back. The angle of breakover should be great enough to minimize the likelihood of injury to the occupants of the seat as well as occupants of seat behind at the minimum anticipated seat pitch. (See ARP 767A.)

3.2 Detailed Provisions:

3.2.1 Seat belt anchor fittings shall accommodate all combinations of the assembly design loads without preloading the seat belt and fittings. Anchor fittings shall be so designed that the seat belt and fittings will be self-aligning. Adjacent anchor fittings shall be arranged to preclude the motion of one fitting to cause the adjacent fitting to disengage.

3.2.2 Seat belt anchor fitting routing shall be as direct as possible to the seat basic structure, but where seat belt anchor fitting position clamps are required, seat belt slack shall not be introduced when the clamps release under seat belt load. Seat belt anchor fittings shall provide lap belt angle specified in ARP 682B. The point of attachment of the seat belt anchor fittings to the basic structure shall be chosen to minimize the motion of the passenger relative to the seat when aircraft deceleration loads are applied. The anchor fitting shall be attached so that failure of adjacent structure will not cause failure of the attachment.

3.2.3 Where seat backs are equipped with integral foodtray tables, closure latches shall retain the table in the closed position under all design load conditions at all possible angles of back recline and breakover and shall be configured so as to minimize head injury to a passenger impacting this area.

3.2.4 Where quick release type fittings are used in the seat retention system, the fittings shall be of the indicating positive action type and suitably protected against inadvertent actuation. Inadvertent misinstallation or release of the fittings shall not be possible.

3.2.5 Seat assembly back and bottom cushion support structure shall be so designed that the deflection under the design load conditions will not cause the occupant(s) to contact seat structure of a type likely to cause injury to the occupant(s). On seats equipped with removable or folding armrests, consideration shall be given to the seat bottom area exposed when the rests are removed or folded.

3.2.6 Seat recline and control mechanism shall have an override feature so that a reclined seat back may be moved to the upright position without releasing the recline control button and by exerting a force not greater than 15 lb (6.8 kg) near the top of the seat back. Provisions shall be incorporated to lock the seat back in the upright position for continued operation should the recline mechanism fail.

3.2.7 When the seat recline control is actuated and the occupant's weight removed from the seat back, the back shall return to the up-right position at a rate of 30 deg/s ± 15.

3.2.8 When "life jackets" stowage provisions are provided, they shall be readily accessible to the seat occupant with seat belt fastened. (See ARP 577B for placarding and ARP 997 for stowage provisions.)

3.2.9 When seats are equipped with ashtrays of the type removable for cleaning, the ashtray housing shall be sealed to prevent ashes and burning materials from falling down into the seat structure in case the ashtray has been inadvertently removed. Ashtrays in folding armrests shall be designed to minimize probability of ashtray contents falling out when the armrest is folded with the lid left open.

3.2.10 Seat secondary structure shall be designed to meet the handling and service loads, but these shall not compromise seat safety. The following are suggested as criteria for the handling and service ultimate loads:

Aisle Armrests	300 lb (136.1 kg)	Applied downward 3 inches from forward end of armrest.
Aisle Armrests	200 lb (90.7 kg)	Applied sideways 3 inches from forward end of armrest.
Other Armrests	250 lb (113.38 kg)	Applied downward 3 inches from forward end of armrest.

3.2.10 (Continued):

Other Armrests	150 lb (68.03 kg)	Applied sideways 3 inches from forward end of armrest.
Foodtray Tables	150 lb (68.03 kg)	Applied downward and evenly distributed.
Flight Attendant Step	300 lb (136.1 kg)	Applied downward and evenly distributed.
Seat Back	200 lb (90.7 kg)	Applied to the top of the seat back opposite the seat lock in a direction to cause back to recline.

3.2.11 Seat secondary structure shall be designed to reasonable fatigue life criteria. The following are guidelines for handling and service life cycle tests:

20 000 cycles	80 lb (36.28 kg)	(On corner of back opposite to lock in a direction to cause back to recline)
10 000 cycles	50 lb (22.68 kg)	(On end of aisle and center armrests in an inboard and outboard direction)
20 000 cycles	75 lb (34.01 kg)	(On end of center armrests in a downward direction)
20 000 cycles	100 lb (45.35 kg)	(On end of aisle armrests in an upward and downward direction)
50 000 cycles	170 lb (77.1 kg)	(Evenly distributed over seat bottom cushion on the seat frame in a downward direction)
15 000 cycles		(Seat back recline mechanism and linkages)
1 000 cycles		(Seat back breakover system to remain 20 - 35 lb without adjustment)

3.2.11 (Continued):

10 000 cycles	50 lb (22.7 kg)	(Equally distributed down load on food tables in a downward direction)

3.2.12 To minimize the likelihood of injury to the passenger in case of emergency landing, seats equipped with integral foodtray tables shall be designed so that when the table is in the open position and a load sufficient to cause failure is applied to the table, the table will fail in such a manner that no projections or sharp edges will be left that can injure the occupants.

3.2.13 Underseat baggage restraint system shall prevent baggage from becoming loose articles or from entering the aisles under forward or side conditions specified in 3.1.4.

3.2.13.1 The underseat baggage restraint system shall be capable of restraining packages or objects 2.5 inches (6.35 cm) or more high.

3.2.14 Any portion of the seat likely to be used as a step by a passenger or attendant shall be capable of withstanding 300 lb (136.1 kg) downward load.

3.2.15 Seats equipped with foldup armrests shall incorporate means to preclude the armrest from extending beyond adjacent seat backs into the ingress/egress space behind the seat.

3.2.16 Special seats to be used by handicapped passengers shall have a means of moving the aisle armrests to allow safe, comfortable and easy ingress and egress. Particular attention shall be given to providing ingress space with no sharp edges or hard points which could injure the handicapped passenger.

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