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Feasibility Study of an Integrated Safety Seat for Infants and Children Under the Age of Two Traveling in Commercial Aircraft

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FEASIBILITY STUDY OF AN INTEGRATED SAFETY SEAT FOR INFANTS AND CHILDREN UNDER THE AGE OF TWO TRAVELING IN COMMERCIAL AIRCRAFT

by

Muneer A. Bakhsh

A Thesis Submitted to the School of Aviation in Partial Fulfillment of the Requirements for the Degree of Master of Aeronautical Science

Embry-Riddle Aeronautical University
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This thesis was prepared under the direction of the candidate's thesis committee
chair, Dr. Charles Richardson, Department of Applied Aviation Sciences, and
has been approved by the members of his thesis committee. It was submitted to
the School of Aviation and was accepted in partial fulfillment of the requirements
for the degree of Master of Aeronautical Science.

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DEDICATION

In the Name of Allah The Most Beneficent, The Most Merciful

To my Mother, and late Father,

Without Allah, then your encouragement, constant support, and unconditional love, my existence and this thesis would have not been possible. Thank you.

To my wife and son,

you bring happiness and joy to my life. Thank you for unfailing patience and support.
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ABSTRACT

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The purpose of this study was to investigate the feasibility of integrated safety seat for children and infants onboard commercial aircraft. The researcher collected and analyzed data on the subject of safety seats for children and infants onboard commercial aircraft. The 115 participants for this study were randomly selected from the population of parents boarding commercial aircraft with infants and/or children. The research method used was descriptive and also compared the integrated safety seats for infants and children in automobiles to commercial aircraft. The survey examined whether or not parents were interested and willing to pay for an integrated safety seat, if available to them. Eighty-six percent were interested in paying for a seat designed for their children/infants. Appropriate recommendations were made, to address safety issues involving infants and children.
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LIST OF ABBREVIATIONS

AFA: Association of Flight Attendants.
ATD: Anthropomorphic Test Dummies.
CAMI: Civil Aeromedical Institute.
CFR: Cod of Federal Regulations.
CRABI: Child Restraint and Air Bag Interaction.
CRD: Child Restraint Device.
CRS: Child Restraint system.
DOT: Department of Transportation.
FAA: Federal Aviation Administration.
FAR: Federal Aviation Regulation.
HIC: Head Injury Criteria.
NTSB: National Transportation Safety Board.
Introduction

On July 19, 1989 at 4:04 p.m., United Airlines flight 232 crash landed in Sioux City, Iowa. A 23-month old infant was placed on the floor between his mother’s feet. During the crash, she could not hold her son securely due to the force of impact and saw her son’s body “flying” toward the rear cabin. She was not injured, but her son died of asphyxia (Nader & Smith, 1994, p.174).

There is a tremendous need for improved child and infant safety on commercial aircraft. Some car seats are approved for use on airplanes, but they are limited. Allowing an infant or child to sit on the lap of an adult, or use a belly belt attached to the parent’s seat belt, are not the safest methods of protection. Designing an integrated safety seat for children and infants is an option which might reduce the unnecessary injuries and fatalities, if not prevent them.

In 1990, the FAA estimated that about four million lap babies fly on commercial aircraft each year. That is more than 10,000 a day (H.R.4025: To amend, 1990a). The Association of Flight Attendants (AFA) has been a strong advocate of mandatory aircraft child restraint seats for nearly 10 years. The FAA states, “....... the Administrator shall consider the duty of an air carrier to provide service with the highest possible degree of safety in the public interest.” Another advocate of aircraft child restraints, the National Transportation Safety Board (NTSB), first recommended the use of the seats in 1989, after the crash of the United flight 232 in Sioux City.
There is a campaign called Turbulence Happens. It is an FAA sponsored national public awareness campaign designed to educate airline passengers on how to avoid injury caused by turbulence. This campaign was launched to raise a public awareness that turbulence can cause injury to unrestrained passengers. During turbulence, children weighing less than 40 pounds should be securely placed in an approved child restraint system. Often less tragic, but just as compelling, are the injuries to children sustained due to in-flight turbulence. Children/infants that are standing or laying on parent’s knees or held on the shoulders, are susceptible to every jolt, bounce, or lunge of the plane. This child/infant can become a flying object in the cabin if a parent loses the grip on the child/infant. "In the event of a crash these children become missiles," said Matthew McCormick, head of safety board group that study how to make crashes more survivable (Lunsford, 1995, p. A1).

In 1994, Jim Hall of the NTSB wrote the FAA stating “The efficacy of infant restraints for children under two years old and currently marketed for use of air carrier aircraft greatly exceeds the efficacy of holding a child on an adult’s lap which is permitted by current regulations." Also in testimony of honorable Jim Hall, Chairman, NTSB, he stated that “Every thing in a plane is secure except our little ones” (personal communication).

The Federal Aviation Administration (FAA) strongly recommends, but does not mandate, that all children who fly, regardless of their age, must use the appropriate restraint system based on their size and weight:

1. Infants under 20 pounds be placed in a rear-facing Child Restraint System (CRS).
2. Children 20 to 40 pounds use an approved forward facing child restraint.
3. Children over 40 pounds may safely use an aircraft seat belt.
These children/infants are not required to occupy a seat, nor are they required by law to be protected by an approved CRS. These children/infants are called in the aviation industry “in-lap infants.” Until the FAA mandates the use of child restraint systems on airplanes, many parents will continue to have a false sense of security that holding their child is adequate. Today’s parents are left with three choices from regulations drafted 50 years ago:

1. Hold the child on their lap.
2. Take a child restraint seat and hope for an empty seat.
3. Purchase a seat for the child and the safety seat.

Accidents involving children/infants.


On May 28, 1985, an Eastern Airlines flight encountered turbulence. An 8-month-old infant was thrown from the seat and hit the cabin ceiling. The infant sustained injuries. A second infant on the same flight was jolted from his
mother's arms and fell on the floor. That infant was not seriously injured (Nader & Smith, 1994).

On July 13, 1986, an Eastern Airlines A-300 encountered turbulence as it was landing in Miami, Florida. An unrestrained 7-month-old infant flew upward and fell down, sustaining a contusion to the left temple (NTSB Safety Recommendation # A-90-078, 1990).


On June 6, 1989, a United Airlines DC-10, encountered severe turbulence. A lap-baby was lost by the mother and ended up underneath garment bags that piled onto the cabin floor when the garment bag closet door broke (Nader & Smith, 1994).

On January 20, 1990, an American Airlines DC-10 encountered turbulence near San Juan, Puerto Rico. The seat belt sign was “ON.” An investigation revealed that an unrestrained 7-week-old infant sustained serious head injuries. The infant was the only passenger who sustained serious injuries on that flight (NTSB Safety Recommendation #A-90-78, 1990).

On January 25, 1990, an Avianca Airlines B-747 crashed in Cove Neck, New York, with 149 passengers, among them were 7 infants under 2 years old. A 4-month-old infant sustained fatal injuries. The six other infants who were between the ages of 4 months and 18 months, sustained serious injuries (NTSB Safety Recommendation #A-90-78, 1990). The NTSB report stated, “Surviving passengers who held infants reported that during the impact the infants were ejected from their grasp and that they were generally unable to locate them in the darkness after the impact. The safety board believes that the problems
experienced in this and other accidents illustrate the impossibility of parents holding on to infants during a crash. If the infants had occupied aircraft approved restraint systems, injuries most likely would not have been as severe." (NTSB Safety Recommendation #A-90-78, p. 6, 1990)

On January 5, 1993, an American Airlines Boeing 767 encountered clear air turbulence shortly after takeoff while the seat belt sign was “ON.” A lap infant was jolted from his mother’s arms but was caught by the mother before he could be injured (Nader & Smith, 1994). Another tragedy occurred in July of 1994, USAir flight 1016 crashed after encountering microburst-induced wind shear during its approach into Charlotte, North Carolina. When the impact occurred, it forced a 9-month-old girl out of her mother’s arms. The girl suffered a fatal blow to the head. When the NTSB interviewed the mother, she stated that she would have paid for a separate seat for her daughter, but was told the infant did not need a separate seat (Akey, 1998).

Investigators believe that many of these incidents/accidents involving children and infants, could be avoided if some form of CRS were used. The House of Representatives on March 23, 1995, Mr. Lightfoot (for himself, Mr. Lazio of New York, Mr. Clinger, Mr. Dornan, Mr. Lantos, Mrs. Meek of Florida, Mrs. Maloney, Mr. Nadler, Mr. Rahall, Mr. Schafer, Mr. Shays, Mr. Stak, Mr. Vento, Mr. Weldon of Florida, and Mr. Wynn) introduced a bill which was referred to the Committee on Transportation and Infrastructure. H.R 1309 a Bill to amend title 49, United States Code, to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft.

The FAA’s first regulatory policies concerning a CRS to be used in airplanes were introduced in 1982. The policy was in the form of Technical Standard Order (TSO). Prior to this order, the passenger who was using a CRS was not allowed to use it during take off or landing. However, according to FAR
121.311, stated child restraint brought on board an airplane must be treated as carry on baggage. Most of the accidents/incidents occur during take off and landing when the CRS is most needed.

A Moving Kids conference was held in Richmond, Virginia, at which the FAA Administrator, Jane Garvey, said, "We at the U.S. Department of Transportation (DOT) have a very important program to improve the safety of our children, and we are working to get the word out to as many people as we can. That's why for the second year the DOT has taken its show on the road, bringing the Moving Kids Safely message where it is needed: in the communities." She also mentioned that more than 3,200 children died each year in all modes of transportation, and hundreds of thousands are injured and hospitalized. Garvey also said conferences are designed to bring together a blend of government, professional, and concerned citizens “who are all seeking to ‘move kids safely’ across all modes of transportation.” Also, in this conference the administrator announced that the FAA has issued a notice asking the public for comments on how the FAA should proceed with a rule to require the use of “Child Restraint Systems” for children under the age of two traveling on U.S. air carriers (Child safety seats, 1997).

Safety advocates and frustrated parents say that seats designed for autos often do not fit properly in planes, even when the seats have been certified for airlines use. The problem is most common with forward-facing seats for kids over 20 pounds. Those seats may have a base wider than 16 inches, too big for an airline seat. Parents also find that some seat belts on planes do not fit properly so the safety seat is not tightly secured (Rosato, 1998).

The executive director of The National Safe Kids Campaign, said “There is no seat that's clearly made to fit all airplane seats, that's the problem.” In contrast, the FAA maintains that most child seats do fit well in airplane seats.
Frances Wokes, Chief of Cabin Safety Standards at Transport Canada, says “It's an imperfect world and these are imperfect seats, but it's better than having a child fly in the arms of a parent” (Rosato, 1998).

Statement of the Problem

This study will investigate the feasibility of designing an integrated safety seat for infants and children on commercial aircraft. An existence of such a seat would enhance the safety of infants and children who have not yet reached their second birthday. In addition this study will research the acceptance of passengers who are traveling with their children and airlines safety officials for an integrated safety seat.
Assumption and Limitation of the Study

Certain assumption were necessary in order for the researcher to formulate the research plan. These assumptions include:

1. To the best of the researcher's knowledge, there has been no research published mentioning or concerning an integrated safety seat for children and infant on commercial aircraft.

2. Some of the participants have never traveled on commercial aircraft before, but they are concerned about the safety issues on commercial aircraft.

3. Each participant has firsthand knowledge of the problem (research).

4. This research does not address the issue of airline infant fare structure.

5. This research does not address the question as to who will furnish the cost or research development of an integrated safety seat for children on commercial aircraft.

6. This research does not address the issue of possible family diversion from air transportation to other modes of transportation.

7. There are certain limitations associated with self-administered survey: the respondents may not understand the questions; may not recall the information; or may be reluctant to give the required information.

8. All participants were asked to volunteer the information to the researcher.

9. The researcher selected only one airport, due to cost constraints.
Definitions

**Federal Aviation Administration (FAA):** is the government agency responsible for aviation safety in the United States; not investigation (Wood & Sweginnis, 1995).

**National Transportation Safety Board (NTSB):** is an independent board charged with investigating all civil aircraft accidents in the United States (Wood & Sweginnis, 1995).

**AFA:** Association of Flight Attendants.

**Air Transportation Association:** The trade association of the U.S. certificated route air carriers (Kane, 1996).

**Aircraft Accident:** Occurrences incident to flight in which, as a result of the operation of an aircraft, any person (occupant or nonoccupant) receives fatal or serious injury or any aircraft receives substantial damage. (Wood & Sweginnis, 1995).

**Substantial damage:**
1) Damage or failure which adversely affects the structural strength, performance, or flight characteristics of the aircraft, and would normally require major repair replacement of the affected component.
2) Engine failure, damage limited to an engine, bent fairing or cowling, dented skin, small punctured holes in the skin or fabric, ground damage to rotor or propeller blades, damage to landing gear, wheels, tires, flaps, engine accessories, brakes, or wing tips are not considered” substantial damage (Wood & Sweginnis, 1995).
Fatal injury: any injury which results in death within 30 days of the accident (Wood & Sweginnis, 1995).

Incident: An occurrence, other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operations. (Wood & Sweginnis, 1995).

In-Lap Infant: A child under the age of two held by an adult during flight instead of being restrained in a child safety restraint system (NTSB Safety recommendation #A-90-78, 1990).
Review of Related Literature

There have been numerous studies and experiments on infant/child safety car seats and restraint devices. However, the studies that have been performed for automobile/airplane safe seats are minimal. Both increased awareness and use of approved automobile child restraints by the public may escalate the use of such restraints on commercial flights. It is of the utmost importance that the standards governing the performance of child restraints results in products that meet the expectations of the user, the automotive industry, and the aviation community (Gowdy & DeWeese, 1994). According to the FAA (1978), it is incumbent on the restraint system designer to avoid high, localized forces that may act on the child. Distribution of impact forces provided by restraint devices is necessary for optimum protection of infants and children.

Built-in or integrated safety seats provide security for the child by making the seat difficult to dislodge in a crash. They place the child farther away from the seat, reducing the risk of head injury (Taylor, 1985). It is important to get away from the notion that holding on to children during a crash, or in turbulence, is sufficient. It is not recommended to hold children or to wrap them in blankets on the cabin floor (Stoller, 1995). There is much to be considered when it comes to child restraint devices, like seat location and proximity to an accompanying adult. For example, the seat need not to be placed next to an emergency exit, or in an aisle seat (Gowdy & DeWeese, 1994).

The NTSB, has reported on the subject of infants/children on airplanes and believes the problems experienced illustrate how impossible it is for parents to hold on to children during aircraft accident or turbulence. NTSB confirms that with use of the proper restraint device injuries to infants/children most likely would not be as severe (Nader & Smith, 1994).
In the safety recommendation by the NTSB on May 30, 1990, the Safety Board found confusion among parents of infants regarding the use of child safety seats considered acceptable by the FAA. For example, all child safety seats manufactured after February 26, 1985 contain a label that states: “This restraint is certified for use in Motor Vehicles and Aircraft.” Confusion also exists among air carrier personnel about whether automobile child safety seats should be used. Parents have sometimes been told that the FAA prohibits use of child safety seats even though seats contain the label that states they can be used in aircraft. Some parents have been told that they can use the seats during flight, but not during takeoff and landing. More confusion exists among airlines personnel about the exact age of the child to be placed on a seat. In an accident in Sioux City, Iowa, a 26 month old child was placed on the floor, thinking that was the most secure place to put him. The child sustained serious injuries (NTSB Recommendation #A-90-78, 1990, p. 5).

The FAA has joined forces with crewmember organizations and airline companies in a coalition known as Partners in Cabin Safety (PICS). PICS is exploring ways to inform and educate passengers while finding ways to effectively prosecute offending air travelers. Child restraint subject areas address safety issues associated with the commercial aviation transportation of children under the age of two years. Congressional, NTSB, and public concerns exist that these children are not safely secured when held by an adult or when a child restraint system approved for automobiles is used. Further, the Gore Commission recommends revising current rules to require the use of approved child restraint systems. The FAA has issued an advanced notice of proposed rulemaking to obtain technical information about child restraint systems. The PICS are exploring means to provide public awareness and education. The expected outcome from this coalition is to educate the public and have them
understand the importance of properly securing children during flight (FAA, Cabin Safety, 1997) [on line].

In 1990 the FAA issued a proposal to all air carriers to accept approved child restraint systems provided by a parent or guardian. The FAA also welcomed any comments concerning this issue. In addition, they are concerned about the safety of infants under the age of two years old, and strongly advocate parent’s use of child restraint (Child Restraint Systems, 1990).

Evidence from highway transportation shows that proper child restraint systems reduce injuries to infants and save infant lives. As a result, every state now has a child restraint requirement for automobiles. On the other hand, regulation and practice in aviation, infants may travel on the lap of parent or guardian and are not required to be placed in a restraint system (Child Restraint Systems, 1990). This assumption was based upon the low accident rate in aviation, and the extremely small risk of injury to unrestrained infants.

Nevertheless, in many survivable accidents, the forces generated by the crash can exceed the parents’ physical ability to restrain a child safely. Also, in clear air turbulence it is possible similarly high forces could be generated, which lead to a significant danger to unrestrained infants. “Neither the FAA nor the NTSB is able to identify the number of infants who travel in the aviation system.” (Child Restraint Systems, 1990, p. 7415). Similarly, the FAA lacks sufficient data regarding injuries and fatalities to infants to accurately analyze the impact of making child restraints mandatory.

**Legislation.**

In the United States, civil aviation is expected to grow about four to six percent per year, that is according to research from the FAA, the International Civil Aviation Organization (ICAO), and Boeing. The traveling public is ultimately feeling this growth, and also this growth can not be occurring without accidents.
According to the FAA the direct cost of the 1989 DC-10 accident in Sioux City, Iowa totaled more than $300 million (Fiscal year, 1998).

An Aviation Consumer Action Project (ACAP) petition for rulemaking (Docket No. 23833) recommends that air carriers be required to make FAA-approved child restraint systems available to passengers who request them at least 24 hours prior to scheduled flights. Also, another petition for rulemaking from Mr. Stuart R. Miller (Docket No. 25985) recommends the use of a child restraint system for children under three years old. Lastly, the Los Angeles Area Child Passenger Safety Association (LAACPSA), recommends that an approved child restraint system should be required to be used in air carriers (Child Restraint System, 1990).

In a 15-year period of time, the FAA has pinpointed and identified eight commercial airline accidents and incidents that involved children and infants in which a proper restraint system might have reduced the casualties. A study was conducted by the FAA’s CAMI and the Arvin/Calspan Advanced Technology Center, and the results of this study made the FAA consider different alternatives concerning the CRD aboard aircraft (Child Restraint Systems, 1990). The first alternative would be each child under the age of 3 or 40 pounds, would have to be provided with a child restraint system by the operator of an aircraft. If this alternative is adopted, then parents or guardians would have to issue a ticket for children under two years old. Under the current rules a child under less than two years old can travel free when held in the parent’s or guardian’s arms. This alternative would also require the airlines buy approved child safety seats.

Should the FAA make this rule mandatory, it would require a significant economic cost. The cost involved in this alternative would be the seat, which is provided by the airlines and the parent, or guardian who has to buy a ticket for the child. Thus, those families who have a child less than two years old would be
The FAA estimates that the average price for one U.S. scheduled domestic flight is $103.78 (in 1989 dollars) and a U.S. scheduled foreign flight is $281.82. The average price between those two prices is $118.30 per flight. But the airlines charge half of the price of an adult if the child is over two years old. So half of the average would be $59.15 per flight, and this would be the most significant additional cost for children two and under because of a mandatory child restraint rule. The next cost of this alternative is the child restraint system itself. The FAA will use the same price as rental cars for an approved safety seat; they use a charge of $3 a day for a child safety seat.

Totaling these costs together with the average cost of a child ticket would be $62.15 for children under the age of two years old. On the other hand, children between the ages of two and three years old are paying for tickets anyway, so using a child safety seat would cost them an extra $3.00. Many assumptions have not been considered in this cost analysis, for example, the travel reduction, and the airline might charge higher prices than the actual cost (Child Restraint Systems, 1990).

The FAA assumes that a child that is two years old would travel with two adults and another child between the age of two and three years old. Considering the average assumptions cited above, with two full fares and one half fare, the cost would be $295.75 (Child Restraint Systems, 1990). Considering this mandatory rule, the cost to a family would be increased by $62.15. Totaling this amount with the cost of the family would be $357.90, and that is a 21 percent increase.

The annual number of enplanements for infants and children two and under would be 3,310,00. It is estimated that the families of these 700,000 children would refrain from flying because of this additional cost. Finally,
according to the FAA the total cost of a mandatory rule in current dollars, would be $211,716,500 per year (Child Restraint Systems, 1990).

The second alternative is to adopt a rule that makes the use of child restraint systems optional. This alternative means that the parent or guardian should issue the ticket and the child safety seat. The airline could not prohibit the child from using the child restraint system aboard its aircraft. This alternative gives the option to the parent or guardian to have the choice of either holding the infant on the lap or using a child restraint system (Child Restraint Systems, 1990). The FAA proposes to require the airlines to allow the use of an approved child restraint system on its aircraft when requested and provided by the child's parent or guardian, either when a ticket is purchased for a seat or a seat is otherwise made available by the airline for the child use.

In 1992, a final rule amends the Federal Aviation Regulations (FARs) requiring the airlines to allow the use of approved child restraint systems (Child Restraint Systems, 1992). The FAA has received information from several resources; the general public, consumer groups, and Congress that some air carriers do not allow the use of approved child restraint systems aboard airplanes, even when a passenger purchases a ticket for this purpose (Child Restraint Systems, 1992). In response to these concerns the FAA issued the Notice of Proposed Rulemaking (NPRM) No. 90-6, "The NPRM proposed the following revision: Certificate holders would have to accept approved child restraint systems provided by a parent or guardian if a ticket is purchased for a seat in which to place the child restraint system, or the seat is otherwise made available." (Child Restraint Systems, 1990).

On February 12, 1997, the White House Commission on Aviation Safety and Security (the Commission) issued a final report to President Clinton, which included a recommendation on Child Restraint Devices (CRDs) used during
flight. The following is an excerpt from the final report as it relates to CRDs:

The FAA should revise its regulations to require that all occupants be restrained during takeoff, landing, and turbulent conditions, and that all infants and small children below the weight of 40 pounds and under the height of 40 inches be restrained in an appropriate child restraint system, such as child safety seats, appropriate to their height and weight (Child Restraint Systems, 1998).

A bill was presented by Mr. Bond, in 1989, S.1913, this bill requires the use of child restraint systems on commercial aircraft. The bill was presented to the Committee on Commerce, Science, and Transportation. The exact bill was submitted again in 1990. In 1990, another bill was submitted by Mr. Lightfoot (for himself, Mr. Roe, Mrs. Bentley, Mrs. Lancaster, Mr. de Lugo, Mr. FAuntory, Mr. Shays, Mr. Smith of New Jersey, Mr. Fuster, Mr. Foglietta, Mr. Towns, and Mr. English). This bill number was H.R. 4025, it amended the FAA Act 1958 to require the use of child safety restraint systems (CRS) approved by the Secretary of Transportation on commercial aircraft; to the Committee on Public Works and Transportation.

In 1991, another bill by Mr. Bond (for himself, Mr. Danforth, Mr. Grassley, Mr. D'Amato, and Mr. Cranston), this bill number was S. 1877, and it also requires the use of CRS on commercial aircraft; to the Committee on Commerce, Science, and Transportation. In the same year, H. R. 2063, a bill to amend the FAA act 1958 to require the use of CRS approved by the Secretary of Transportation on commercial aircraft; to the Committee on Public Works and Transportation. This bill was by Mr. Lightfoot (for himself, Mr. Roe, Mr. Clinger, Mr. de Lugo, Mr. Shays, Mr. Towns, Mr. Evans, Mr. Horton, Mr. Lagomarsino, Mr. Goodling, Mr. Hunter, Mr. Studds, Mr. Sabo, Mr. Hayes of Illinois, Mrs. Collins of Illinois, Mr. Bilbary, Mr. Dwyer of New Jersey, Mr. Feighan, Mr. Lewis...
of Georgia, Mr. Jacobs, Mr. McDermott, Mr. Serrano, Mr. Engel, Mr. Smith of New Jersey, Mr. Gejdenson, and Mr. Fish). In 1992 the same bills, S.1877 and H.R. 2063 were presented.

H.R. 1533, a bill in 1993 was presented asking for the same contents that was in the past bills, requiring the CRS, on commercial aircraft. In the same year Mr. Bond presented another bill S. 1039, for the same reason.

H. R.1533, a bill was presented in 1994, requiring CRS in commercial aircraft. In 1995, H.R.1309 a bill to amend title 49, United States Code, to require the use of Child Safety Restraint Systems (CSRS) approved by the Secretary of Transportation on commercial aircraft; to the Committee on Transportation and Infrastructure. In 1996, S. 2139 a bill by Mrs. Murray, was presented concerning CSRS on commercial aircraft, and for other purposes; to the Committee on Commerce, Science, and Transportation. In the same year another bill as of 1995, H.R. 1309 was presented again.

In 1997, S. 398 a bill amended title 49, United States Code, to require the use of Child Restraint Systems approved by the Secretary of Transportation on commercial aircraft, and for other purposes; to the Committee on Commerce, Science, and Transportation, was presented by Mrs. Murray. In the same year, another bill H.R. 1141 exactly the same as the previous bill was presented by Mr. Defazio. Also, in 1997 bill H.R. 754 was presented for the same issue, CRS in commercial aircraft. This bill was also presented in 1998. See Appendix C for copies of these bills.

**Codes of Federal Regulations (CFRs).**

All the following CFRs, are as revised on January 1, 1998:

**14CFR91.107** Use of safety belts, shoulder harnesses, and child restraint systems.

(a) Unless otherwise authorized by the Administrator--
(1) No pilot may take off a U.S. registered civil aircraft (except a free balloon that incorporates a basket for gondola, or an airship type certificate before November 2, 1987) unless the pilot in command of that aircraft ensures that each person on board is briefed on how to fasten and unfasten that person’s safety belt and, if installed, shoulder harness.

(2) No pilot may cause to be moved on the surface, take off, or land a U.S. registered civil aircraft (except a free balloon that incorporates a basket or gondola, or an airship type certificate before November 2, 1987) unless the pilot in command of that aircraft ensures that each person on board has been notified to fasten his or her safety belt and, if installed, his or her shoulder harness.

(3) Except as provided in this paragraph, each person on board a U.S. registered civil aircraft (except a free balloon that incorporates a basket or gondola or an airship type certificated before November 2, 1987) must occupy an approved seat or berth with a safety belt and, if installed, shoulder harness, properly secured about him or her during movement on the surface, takeoff, and landing.... etc.

Requirements of this paragraph, a person may:

   (i) Be held by an adult who is occupying a seat or berth if that person has not reached his or her second birthday and does not occupy or use any restraint device;

   (ii) Use the floor of the aircraft as a seat, provided that the person is on board for the purpose of engaging in sport parachuting; or

   (iii) Notwithstanding any other requirement of this chapter, occupy an approved child restraint system furnished by the operator or one of the persons described in paragraph (a)(3)(iii)(A) of this section provided that:

(A) The child is accompanied by a parent, guardian, or attendant
designated by the child’s parent or guardian to attend to the safety of the child during the flight;

(B) Except as provided in paragraph (a) (3) (iii) (B) (4) of this action, the approved child restraint system bears one or more labels as follows:

(1) Seats manufactured to U.S. standards between January 1, 1981, and February 25, 1985, must bear the label: “This child restraint system conforms to all applicable Federal motor vehicle safety standards.” Vest and harness type child restraint systems manufactured before February 26, 1985, bearing such a label are not approved for the purposes of this section:

(2) Seats manufactured to U.S. standards on or after February 26, 1985, must bear two labels:

   (i) “This child restraint system conforms to all applicable Federal motor vehicle safety standards”; and,

   (ii) “THIS RESTRAINTS IS CERTIFIED FOR USE IN MOTOR VEHICLES AND AIRCRAFT” in red lettering;

(3) Seats that do not qualify under paragraphs (a)(3)(iii)(B)(1) and (a)(3)(iii)(B)(2) of this section must bear either a label showing approval of a foreign government or label showing that the seat was manufactured under the standards of the United Nations; and,

(C) The operator complies with the following requirements:

(1) The restraint system must be properly secured to an approved forward-facing seat or berth;

(2) The child must be properly secured in the restraint system and must not exceed the specified weight limit for the restraint system; and,

(3) The restraint system must bear the appropriate label(s).

(4) Notwithstanding any other provision of this section, booster type child restraint systems as defined in Federal Motor Vehicle Safety Standard No. 213
(49 CFR 571.213), vest-and harness-type child restraint system, and lap held child restraints are not approved for use in aircraft; and,

(C) The operator complies with the following requirements:

(1) The restraint system must be properly secured to an approved forward-facing seat or berth;

(2) The child must be properly secured in the restraint system and must not exceed the specified weight limit for the restraint systems; and,

(3) The restraint system must bear the appropriate label(s).

(b) Unless otherwise stated, this section does not apply to operations conducted under part 121, 125, or 135 of this chapter. Paragraph (a)(3) of this section does not apply to persons subject to 14CFR91.105.

4. Section 91.205 is amended by revising paragraph (b)(12) to read as follows:

(b) An approved safety belt with an approved metal-to-metal latching device for each occupant 2 years of age or older.

14CFR121.311. Seats, safety belts, and shoulder harnesses

(a) An approved safety belt

(b) Except as provided in this paragraph, each person on board an airplane operated under this part shall occupy an approved seat or berth with a separate safety belt properly secured about him or her during movement on the surface, takeoff, and landing. A safety belt provided for the occupant of a seat may not be used by more than one person who has reached his or her second birthday. Notwithstanding the preceding requirements, a child may:

(1) Be held by an adult who is occupying an approved seat or berth if that child has not reached his or her second birthday; or,

(2) Notwithstanding any other requirement of this chapter, occupy an
approved child restraint system furnished by the certificate holder or one of the persons described in paragraph (b)(2)(i) of this section, provided:

(i) The child is accompanied by a parent, guardian, or attendant designated by the child's parent or guardian to attend to the safety of the child during the flight;

(ii) Except as provided in paragraph (b)(2)(ii)(D) of this section, the approved child restraint system bears one or more labels as follows:

(A) Seats manufactured to U.S. standards between January 1, 1981, and February 25, 1985 must bear the label: “This child restraint system conforms to all applicable Federal motor vehicle safety standards.”

(B) Seats manufactured to U.S. standards on or after February 26, 1985, must bear two labels:

(1) “This child restraint system conforms to all applicable Federal motor vehicle safety standards;” and,

(2) “THIS RESTRAINT IS CERTIFIED FOR USE IN MOTOR VEHICLES AND AIRCRAFT” in red lettering;

(C) Seats that do not qualify under paragraphs (b)(2)(ii)(A) and (b)(2)(ii)(B) of this section must bear either a label showing approval of a foreign government or label showing that the seat was manufactured under the standards of the United Nations;

(D) Notwithstanding any other provisions of this section, booster type child restraint systems as defined in Federal Motor Vehicle Standard No. 213 (49 CFR 571.213), vest-and harness type child restraint systems, and lap held child restraint are not approved for use in aircraft; and,

(iii) The certificate holder complies with the following requirements:

(A) The restraint system must be properly secured to an approved forward-facing seat or berth;
(B) The child must be properly secured in the restraint system and must not exceed the specified limit for the restraint system; and,

(C) The restraint system must bear the appropriate label(s).

(c) Except as provided in paragraph (c) (3) of this section, the following prohibitions apply to certificate holders:

(1) No certificate holder may permit a child, in an aircraft, to occupy a booster-type child restraint system, a vest-type child restraint system, a harness-type child restraint system, or a lap held child restraint system during take off, landing, and movement on the surface.

(2) Except as required in paragraph (c) (1) of this section, no certificate holder may prohibit a child, if requested by the child’s parent, guardian, or designated attendant, from occupying a child restraint system furnished by the child’s parent, guardian, or designated attendant provided;

   (i) The child holds a ticket for an approved seat or berth or such seat or berth is otherwise made available by the certificate holder for the child’s use;

   (ii) The requirements of paragraph (b) (2) (i) of this section are met;

   (iii) The requirement of paragraph (b) (2) (iii) of this section are met; and,

   (iv) The child restraint system has one or more of the labels described in paragraph (b) (2) (ii) (A) through (b) (2) (ii) (C) of this section.

(3) This section does not prohibit the certificate holder from providing child restraint systems authorized by this section or, consistent with safe operating practices, determining the most appropriate passenger set location for the child restraint system.

14CFR125.211.

Sec. 125.211 Seat and safety belts.

(a) No person may operate an airplane unless there are available during the takeoff, en route flight, and landing—
(1) An approve seat or berth for each person on board the airplane who is at least 2 years old; and,

An approved safety belt for separate use by each person on board the airplane who is at least 2 years old, except that two persons occupying a berth may share one approved safety belt and two persons occupying a multiple lounge or divan seat may share one approved safety belt during en route flight only.

(a) Except as provided in paragraphs (b) (1) and (b) (2) of this section, each person on board an airplane operated under this part shall occupy an approved seat or berth with a separate safety belt properly secured about him or her during movement on the surface, takeoff, and landing. A safety belt provided for the occupant of a seat may; not be used for more than one person who has reach his or her second birthday. Notwithstanding the preceding requirements, a child may:

(1) Be held by an adult who is occupying an approved seat for berth, provided the child has not reached his or her second birthday and the child does not occupy or use any restraining device; or,

(2) Notwithstanding any other requirement of this chapter, occupy an approved child restraint system furnished by the certificate holder or one of the persons described in paragraph (b) (2) (i) of this section, provided:

   (i) The child is accompanied by a parent, guardian, or attendant designated by the child’s parent or guardian to attend to the safety of the child during the flight;

   (ii) Except as provided in paragraph (b) (2) (ii) (D) of this section, the approved child restraint system bears on or more labels as follows:

   (A) Seat manufactured to U.S. standards between January 1, 1981, and February 25, 1985, must bear the label: “This child restraint system conforms to all applicable Federal motor vehicle safety standards”;
(B) Seat manufactured to U. S. standards on or after February 26, 1985, must bear two labels:

(1) "This child restraint system conforms to all applicable Federal motor vehicle safety standards"; and,

(2) "THIS RESTRAINT IS CERTIFIED FOR USE ON MOTOR VEHICLES AND AIRCRAFT" in red lettering;

(C) seats that do not qualify under paragraphs (b) (2) (ii) (A) and (b) (2) (ii) of this section must bear either a label showing approval of a foreign government or a label showing that the seat was manufactured under the standards of the United Nations;

(D) Notwithstanding any other provisions of this section, booster type child restraint systems as defined in Federal Motor Vehicle Standard No. 213 (49 CFR 571.213), vest-and harness-type child restraint systems, and lap held child are not approved for use in aircraft; and,

(iii) The certificate holder complies with the following requirements:

(A) The restraint system must be properly secured to an approved forward-facing seat for berth;

(B) The child must be properly secured in the restraint system and must not exceed the specified weight limit for the restraint system; and,

(C) The restraint system must be the appropriate label(s).

(a) Except as provided in paragraph (c) (3) of this section, the following prohibitions apply to certificate holders:

(1) No certificate holder may permit a child, in an aircraft, to occupy a booster-type child restraint system, a vest-type child restraint system, a harness-type child restraint system, or lap held child restraint system during take off, landing, and movement on the surface.

(2) Except as required in paragraph (c) (1) of this section, no certificate
holder may prohibit a child, if requested by the child’s parent, guardian, or designated attendant, from occupying a child restraint system furnished by the child’s parent, guardian, or designated attendant provided:

(i) The child holds a ticket for an approved seat or berth or such seat or berth is otherwise made available by the certificate holder for the child’s use;

(ii) The requirements of paragraph (b) (2) (i) of this section are met;

(iii) The requirements of paragraph (b) (2) (iii) of this section are met; and,

(iv) The child restraint system has one or more of the labels described in paragraph (b) (2) (ii) (A) through (b) (2) (ii) (C) of this section.

(3) This section does not prohibit the certificate holder from providing child restraint systems authorized by this section or, consistent with safe operating practices, determining the most appropriate passenger seat location for the child restraint system.

**FAR 23.561 General.**

(a) The airplane, although it may be damaged in emergency landing conditions, must be designed as prescribed in this section to protect each occupant under those conditions.

(b) The structure must be designed to protect each occupant during emergency landing conditions when—

(1) Proper use is made of the seats, safety belts, and shoulder harnesses provided for the design;

(2) The occupant experiences the static inertia loads corresponding to the following ultimate load factors—

   (i) Upward, 3.0g for normal, utility, and commuter category airplanes, or 4.5g for acrobatic category airplanes;

   (ii) Forward, 9.0g;
(iii) Sideward, 1.5g; and,

(3) The items of mass within the cabin, that could inure an occupant, experience the static inertia loads corresponding to the following ultimate load factors--

(i) Upward, 3.0g;

(ii) Forward, 18.0g; and,

(iii) Sideward, 4.5g.

(c) Each airplane with retractable landing gear must be designed to protect each occupant in a landing--

(1) with the wheels retracted;

(2) with moderate descent velocity; and,

(3) Assuming, in the absence of a more rational analysis--

(i) A downward ultimate inertia force of 3g; and,

(ii) A coefficient of friction of 0.5g at the ground.

(d) If it is not established that a turnover is unlikely during an emergency landing, the structure must be designed to protect the occupants in a complete turn over as follows:

(1) The likelihood of a turnover may be shown by an analysis assuming the following conditions--

(i) Maximum weight;

(ii) Most forward center of gravity position;

(iii) Longitudinal load factor of 9.0g; and,

(iv) Vertical load factor of 1.0g; and,
(v) For airplanes with tricycle landing gear, the nose wheel strut failed with the nose contacting the ground.

(3) For determining the loads to be applied to the inverted airplane after a turnover, an upward ultimate inertia load factor of 3.0g and a coefficient of friction with the ground of 0.5 must be used.

**14CFR25.562.**

Sec. 25.562 Emergency landing dynamic conditions.

(a) The seat and restraint system in the airplane must be designed as prescribed in this section to protect each occupant during an emergency landing condition when--

(1) proper use is made of seats, safety belts, and shoulder harnesses provided for in the design; and,

(2) The occupant is exposed to loads resulting from the conditions prescribed in this section.

(b) Each seat type design approved for crew or passenger occupancy during takeoff and landing must successfully complete dynamic tests or be demonstrated by rational analysis based on dynamic tests of a similar type seat, in accordance with each of the following emergency landing conditions. The tests must be conducted with an occupant simulated by a 170-pound anthropomorphic test dummy, as defined 49 CFR part 572, Subpart B, or its equivalent, sitting in the normal upright position.

(1) A change in downward vertical velocity (v) of not less than 35 degree with respect to the horizontal plane and with the wings level. Peak floor
deceleration must occur in not more than 0.08 seconds after impact and must reach a minimum of 14g.

(3) A change in forward longitudinal velocity \( v \) of not less than 44 feet per second, with the airplane's longitudinal axis horizontal and yawed 10 degrees either right or left, whichever would cause the greatest likelihood of the upper torso restraint system (where installed) moving off the occupant's shoulder, and with the wings level. Peak floor deceleration must occur in not more than 0.09 seconds after impact and must reach a minimum of 16g. Where floor rails or floor fittings are used to attach the seating devices to the test fixture, the rails or fitting must be misalign with respect to the adjacent set of rails or fittings by at least 10 degrees vertically (i.e., out of parallel) which on rolled 10 degrees.

(c) The following performance measures must not be exceeded during the dynamic tests conducted in accordance with paragraph (b) of this section:

(1) Where upper torso straps are used for crewmembers, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.

(2) The maximum compressive load measured between the pelvis and the lumbar column of the anthropomorphic dummy must not exceed 1,500 pounds.

(3) The upper torso restraint straps (where installed) must remain on the occupant's shoulder during the impact.

(4) The lap safety belt must remain on the occupant's pelvis during the impact.
(5) Each occupant must be protected from serious head injury under the conditions prescribed in paragraph (b) of this section. Where head contact with seats or other structure can occur, protection must be provided so that the head impact does not exceed a Head Injury Criterion (HIC) of 1,000 units.

**14 CFR 135.128.**

Sec. 135.128 Use of safety belts and child restraint systems.

(a) Except as provided in this paragraph, each person on board an aircraft operated under this part shall occupy an approved seat or berth with a separate safety belt properly secured about him or her during movement on the surface, takeoff, and landing...etc. A safety belt provided for the occupant of a seat may not be used by more than one person who has reached his or her second birthday. Notwithstanding the preceding requirements, a child may:

(1) Be held by an adult who is occupying an approved seat or berth, provided the child has not reached his or her second birthday and the child does not occupy or use any restraining device; or,

(2) Notwithstanding any other requirement of this chapter, occupy an approved child restraint system furnished by the certificate holder or one of the persons described in paragraph (a) (2) (i) of this section, provided:

(i) The child is accompanied by a parent, guardian, or attendant designated by the child’s parent or guardian to attend to the safety of the child during the flight;

(ii) Except as provided in paragraph (a) (2) (ii) (D) of this section, the approved child restraint system bears one or more labels as follows:
(A) Seats manufactured to U.S. standards between January 1, 1981, and February 25, 1985, must bear the label: “This child restraint system conforms to all applicable Federal motor vehicle safety standards”;

(B) Seat manufactured to U.S. standards on or after February 26, 1985, must bear two labels:

(1) “This child restraint system conforms to all applicable Federal motor vehicle safety standards”; and,

(2) “THIS RESTRAINT IS CERTIFIED FOR USE IN VEHICLES AND AIRCRAFT” in red lettering;

(C) Seats that do not qualify under paragraphs (a) (2) (ii) (A) and (a) (2) (ii) (B) of this section must bear either a label showing approval of a foreign government or label showing that the seat was manufactured under the standards of the United Nations;

(D) Notwithstanding any other provision of this section, booster type child restraint systems as defined in Federal Motor Vehicle Standard No. 213 (49 CFR571.213), vest-and harness-type child restraint systems, and lap held child restraints are not approved for use in aircraft; and,

(iii) The certificate holder complies with the following requirements:

(A) The restraint system must be properly secured to an approved forward-facing seat or berth;

(B) The child must be properly secured in the restraint system and must not exceed the specified weight limit for the restraint system; and,

(C) The restraint system must bear the appropriate label(s).
(b) Except as provided in paragraph (b) (3) of this section, the following prohibitions apply to certificate holders:

(1) No certificate holder may permit a child, in an aircraft, to occupy a booster-type child restraint system, a vest-type child restraint system, a harness-type child restraint system, or lap held child restraint system during take off, landing, or movement on the surface.

(2) Except as required in paragraph (b) (1) of this section, no certificate holder may prohibit a child, if requested by the child’s parent, guardian, or designated attendant, from occupying a child restraint system furnished by the child’s parent, guardian, or designated attendant provided:

(i) The child holds a ticket for an approved seat or berth or such seat or berth is otherwise made available by the certificate holder for the child’s use; ... etc.

(3) This section does not prohibit the certificate holder from providing child restraint systems authorized by this or, consistent with safe operating practices, determining the most appropriate passenger seat location for the child restraint system.

49CFR571.213.

Sec. 571.213 Standard No. 213; child restraint systems.

S1. Scope: This standard specifies requirements for child restraint systems used in motor vehicles and aircraft.

S2. Purpose: The purpose of this standard is to reduce the number of children killed or injured in motor vehicles and aircraft.
S3. Application: This standard applies to passenger cars, multipurpose passenger vehicles, trucks and buses, and to child restraint systems for use in motor vehicles and aircraft.

S4. Definitions:
Add-on child restraint systems means any portable child restraint system.

Backless child restraint system means a child restraint, other than a belt-positioning seat, that consists of a seating platform that does not extend up to provide a cushion for the child’s back or head and has a structural element designed to restrain forward motion of the child’s torso in a forward impact.

Belt-positioning seat means a child restraint system that positions a child on a vehicle seat to improve the fit of a vehicle Type II belt system on the child and that lacks any component, such as belt system or a structural element, designed to restrain forward movement of the child's torso in a forward impact.

- Booster Seat means either a backless child restraint system or a belt-positioning seat.

- Built-in child restraint system means a child restraint system that is designed to be an integral part of and permanently installed in a motor vehicle.

- Car bed means a child restraint system designed to restrain or position a child in the supine or prone position on a continuous flat surface.

Child restraint system means any device except Type I or Type II seat belts, designed for use in a motor vehicle or aircraft to restrain, seat, or position children who weigh 50 pounds or less.
- Contactable surface means any child restraint system surface (other than that of a belt, belt buckle, or belt adjustment hardware) that may contact any part of the head or torso of the appropriate test dummy, specified in S7, when a child restraint system is tested in accordance with S6.1.

- Factory-installed built-in child restraint system means a built-in Child Restraint System that has been or will be permanently installed in a motor vehicle before that vehicle is certified as a completed or altered vehicle in accordance with part 567 of this chapter.

- Rear-facing Child Restraint System means a child restraint system, except a car bed, that positions a child to face in the direction opposite to the normal direction of travel of the motor vehicle.

- Representative aircraft passenger seat means either a Federal Aviation Administration approved production aircraft passenger seat or a simulated aircraft passenger seat conforming to Figure 1.

- Specific vehicle shell means the actual vehicle model part into which the built-in child restraint system is or is intended to be fabricated, including the complete surroundings of the built-in system. If the built-in child restraint system is or is intended to be fabricated as part of any seat other than a front seat, these surroundings include the back of the seat in front, the interior rear side door panels and trim, the floor pan, adjacent pillars, and the ceiling.

- Torso means the portion of the body of a seated anthropomorphic test dummy, excluding the thighs, that lies between the top of the child
restraint system seating surface and the top of the shoulders of the test dummy.

S.5. Requirements: (a) Each motor vehicle with a built-in child restraint system shall meet the requirements in this section when, as specified, tested in accordance with S6.1 and this paragraph.

*Figure 1. Simulated Aircraft Passenger Seat*

"A" represents a 2-to 3-inch thick polyurethane foam pad, 15-20 pounds per cubic foot density, over 0.020-inch-thick aluminum pan, and covered by 12-to 14-ounce marine canvas. The sheet aluminum pan is 20 inches wide and supported on each side by a rigid structure. The seat back is a rectangular frame covered with the aluminum sheet and weighing between 14 and 15 pounds, with a center of mass 13 to 16 inches above the seat pivot axis. The mass moment of inertia of the seat back about the seat pivot axis is between 195 and 220 ounce-inches-second square. The seat back is free to fold forward about the pivot, but a stop prevents rearward motion. The passenger safety belt anchor points are spaced 21 to 22 inches apart and are located in line with seat pivot axis. (Child Restraint Systems, 1997)
Child restraint system’s testing on commercial aircraft.

There have been a number of testings concerning the issue of child restraint systems on commercial aircraft, yet they are very limited. The first published test about child restraint system performance on aircraft was conducted in March, 1978 by Richard F. Chandler and Edwin M. Trout, in the Civil Aeromedical Institute (CAMI), for the FAA. The test was performed to simulate aircraft crash and turbulence conditions. There were six typical systems exposed to controlled impacts on a test sled. The report discussed the characteristics and the results of the (CRS) that are critical for civil aircraft applications. The results of the tests for these six typical systems are described in Table 1 for dynamic test results, and Table 2 for turbulence simulation results. In conclusion, the report states “The test program provided a reasonably severe evaluation of child restraint systems”

The research had many problems evaluating the infant and children restrain systems, the problems are:

Lack of quantitative measures to indicate crash injury in an infant or child.
Lack of an adequate surrogate for the infant or child in performing tests.
Most aircraft seat backs, unlike modern automobile seat backs, are not latched to remain upright during impact.
Table 1

**Dynamic test results**

<table>
<thead>
<tr>
<th>Restraint:</th>
<th>Dummy</th>
<th>Head Displacement</th>
<th>Seat Back Rotation</th>
<th>Lap Belt Loop Load</th>
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<tbody>
<tr>
<td>Lap belt:</td>
<td>Infant</td>
<td>22.5</td>
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<td>Tot-Guard:</td>
<td>3-yr-old-child</td>
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<td>47</td>
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<td>3-yr-old-child</td>
<td></td>
<td>17.0</td>
<td>42</td>
<td>2,350</td>
</tr>
<tr>
<td>Peterson child:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-yr-old-child</td>
<td></td>
<td>20.3</td>
<td>62</td>
<td>1,900</td>
</tr>
</tbody>
</table>

Table 2

Turbulence simulation results

<table>
<thead>
<tr>
<th>Restraint:</th>
<th>Dummy</th>
<th>Pitch forward</th>
<th>Pitch Rearward</th>
<th>Roll Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lap Belt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infant</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>3-yr-old-child</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Ford Tot-Guard:</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Infant</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>3-yr-old-child</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Bobby-Mac:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infant</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Mopar:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infant</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>3-yr-old-child</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>GM Infant</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sears/Rose:</td>
<td>Infant and 3-yr-old-child</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Peterson Infant:</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Peterson Toddler:</td>
<td>Infant</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>3-yr-old-child</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Peterson Child:</td>
<td>3-yr-old-child</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: From "Child restraint systems for civil aircraft," by R F Chandler and E M Trout, 1978
Civil Aeromedical Institute (CAMI), FAA

In 1971 the National Highway Traffic Safety Administration (NHTSA) adopted the Federal regulatory specification to provide special means of protecting infants and small children during a crash (Chandler & Trout, 1978). The Motor Vehicle Safety Standard (MVSS) number 213 established some static testing and requirements that could provide some protection for infants and children on aircraft. However, when parents/guardians provided a seat for an
infant or a child that is approved by MVSS 213, they have been told that they can not use the seat during takeoff and landing. Unfortunately, the MVSS 213 standards for the use on aircraft are not adequate (Chandler & Trout, 1978).

In conclusion, the report stated “The test program provided a reasonably severe evaluation of child restraint systems. The basic concepts leading to this test program can be incorporated into a test specification to establish a repetitive test method. A uniform test procedure must be established, guidance must be provided regarding allowable locations for child restraint seats in the aircraft, and a means of notifying the public and aircraft operators of the acceptable seats must be devised” (Chandler & Trout, 1978, p. 12)

After this research was conducted, there were three more studies done. The first, was by Naab at Calspan, tested 98 CRDs installed on an airplane fixture. The test was performed under FMVSS-213 requirements, at 20 miles per-hour (22ft/sec), which is half the impact velocity currently specified in the current FMVSS-213 (Gowdy & DeWeese, 1994). “Also, the vehicle peak acceleration for most of the Calspan tests was approximately 17G’s, whereas, the current FMVSS-213 requirement is a minimum of 24G’s”(Gowdy & DeWeese, 1994, p. 2).

The second test was conducted by Hardy at the Cranfield Institute in England. The test was conducted with forward facing CRD at an impact severity of 22 ft/sec., and the aft facing CRDs were tested at 16Gpk (Gowdy & DeWeese, 1994). “The Cranfield report noted that few, if any, of the automotive child restraints built to meet automobile standards would pass the requirements in an
airplane seat "(Gowdy & DeWeese, 1994, p. 2). Important results were concluded in this report, the first one, when placing unrestrained infants on the lap of an adult is "... Likely to promote fatalities and injuries to these children in an impact situation." The second, is "...may promote other injuries due to the manner in which the restraining forces will be transmitted to the children" (Gowdy & DeWeese, 1994, p. 3).

The third and last published test that concerns the issue of CRDs on commercial aircraft, was conducted in 1994, by Van Gowdy and Richard DeWeese, for the FAA Civil Aeromedical Institute (CAMI). The report dated September 1994, was titled "The performance of child restraint devices in transport airplane passenger seats". This report pointed out significant differences exist between the test fixture specified in FMVSS-213 and the typical commercial aircraft. Figure 2 demonstrates the differences between an automobile seat and an aircraft set. Some of the differences are:

Figure 2. The Difference Between an Automobile Seat and Aircraft Seat.
1. The fixtures in Automobiles (FMVSS-213) and aircraft passenger seat are at different heights.

2. The back of an aircraft seat rotate forward, but in an automobile does not have this feature, so during an impact the aircraft seat tends to breakover.

3. Automobile seat buckle is located to the inboard side of the occupant when in use, where the aircraft seat belts are manually adjusted and the range of adjustment is very limited.

4. Aircraft seat buckles are usually two-inch webbing of the belt, and it’s release mechanism and space is required above the buckle in order to release it, whereas in an automobile it is just a push of a button to release the buckle.

5. The typical distance between the armrests in an economy class of an aircraft is 16.5 to 17.5 inches. The automobile fixtures have no armrests, which provide a wide of range unobstructed cushion for the CRD installation.

**Comparison: FMVSS-213 and FAR 25.562.**

There are some similarities and differences between the pass-fail criteria in FMVSS-213 and FAR 25.562. The Head Injury Criteria (HIC), which is the head injury protection measurement, and it is a numerical computation performed on head acceleration data. If the HIC exceeds 1000, it is an indication of a serious injury. This measurement is the same in both regulations (Gowdy & DeWeese, 1994).

The minimum peak acceleration in FAR 25.562 is 16G’s where in the FMVSS-213 is 24G’s. For commercial aircraft the vertical impact severity is less than the horizontal test severity. This is to insure that the spinal loads not to
exceed a specified criterion of 1500 pounds (Gowdy & DeWeese, 1994). Another important difference is the FAR reject any load on abdominal region above the pelvis, which is caused by the lower torso restraints, whereas the FMVSS-213 does not prohibit abdominal loading at all (Gowdy & DeWeese, 1994).

This report has tested six different types of CRDs, booster seats, forward facing convertible carriers, aft facing carriers, torso harness, lap held child restraint, and passenger seat lap belts. The test used four types of Anthropomorphic Test Dummies (ATDs). Two are standard child ATDs as defined in 49 CFR part 572, a three year old part 572-C with instrumentation, and 6-month old non-instrumented. The third type was a 6-month old identified as the "Child Restraint and Air Bag Interaction" (CRABI), it has head and chest instrumentation. The fourth ATD was an experimental 24-month old identified as CAMIX.

In conclusion, the test report stated the findings as follows:

1. Booster Seats, may expose the child occupant to potential abdominal injury due to the combined effects of forces imparted from the aft row occupant and seat back breakover.
2. Forward Facing Carriers are difficult to install and adjust properly in economy class passenger sets.
3. Aft Facing Carriers, convertible as well as non-convertible models, installed in airplane seats are a definite safety benefit for children weighing less than 20 pounds.
4. Harness System; do not interface with the airplane seat lap belts in a manner,
which adequately restrains forward motion.

5. A Lap Held Child Restraint; or Belly Belt, should not be considered a means of protecting a child from injury during an accident.

6. Normal Lap Belts; can provide acceptable restraint for children of a size represented by the 3 year-old ATD used in this project.

Finally, the report’s remarks were “These conclusions should not be construed as an indication that a dangerous condition exists for children traveling in commercial transport airplanes. The accident rate for commercial operations in 1991 was 0.32 per 100,000 departures, which affirms the fact that commercial aviation is a very safe mode of transportation. Rather, this information is presented to identify a particular component of passenger safety, child restraints, which may not meet the expected levels of performance in an accident. The data and observations in this report are provided to the aviation community, restraint manufacturers, and government agencies to further enhance the safety for children traveling in airplanes.” (Gowdy & DeWeese, 1994).
The automobile industry.

In the United States the single largest cause of fatalities is motor vehicle crashes, responsible for more than 1,800 deaths of youngsters age 14 and under each year, according to the National Safe Kids (Job & Bellscheidt, 1999). However, 700 children under age five die in automobile crashes each year, and 60,000 to 70,000 are injured (Consumer Reports, September 1995).

A Washington DC, based child safety advocacy group estimates another 280,000-plus children are injured each year while riding in vehicles. Yet, safety tests show the risk of injury or death for a child can be reduced as much as 70 % if an unrestrained child is put into a child safety seat (Job & Bellscheidt, 1999).

According to a federal government study, the improper use of child seats was 80 %. Between 1997 and 1998, the National Safe Kids, checked more than 17,000 child safety seats in automobiles at a nationwide checkups, and said the figure is closer to 85 % (Job & Bellscheidt, 1999). Recognizing the inadequacies of child restraints, the National Highway Safety Bureau of the U.S. Department of Transportation (DOT) implemented specific regulations for children restraints in a new standard, FMVSS-213, which the improved version of this standard took effect in January 1981 (Shew & Daris, 1995).

A major problem with child car safety, is the improper installation of the seats, parents just don't follow the instructions (Daly, 1999). Many children ride in child safety seats that are not properly secured, one survey of nearly 6,000 children found that only 21 % of children in safety seats were properly restrained.
(NHTSA, 1996).

What’s the purpose of using a car seat?

When properly restrained, a child’s car seat:

1. Prevents ejection of the child from car seat and/or vehicle.
2. 5-point harness restrains baby at strongest points of the body.
3. Spreads the crash forces over a wide area, so the car seat absorbs a lot of the crash energy rather than the child’s body.
4. In a crash, the car seat helps to “ride down” the impact.
5. Minimize “head excursion” in a crash.
6. Prevents contact with hard surfaces inside the vehicle, other occupants, the road, or other vehicles.
7. Reduces fatalities for infants 71 % in cars; 58 % in vans/light trucks; ages on to four... 54 % cars; 59 % in vans/light trucks (1999 Kohl Designs & Way Forward Technology, Inc.).
Economical analysis of child restraints.

There are three major types of child restraints, the convertible model, an infant model, and booster seat model. The first type can be used for a child up to five years old. The second type, can be used for the first year of the child's life. The third type is for children from five to seven years old. Shaw and Dardis, concerning these types of child restraints have conducted an economical analysis. The research objective was to examine the cost per life saved for child restraints that have been used in 1987. Table 3 estimates the Sales of Infant and Convertible Restraints between 1984 and 1987 (Shaw & Dardis, 1995). In this research, the cost per life years saved was calculated based on useful life of four years and varies according to prices and discount rate. The following formula is used to estimate the total costs of child restraints to the number of life years saved.

\[ TCOST = AC \sum_{r=1}^{1/1+i} + BC \sum_{r=1}^{b/(1+i)} \]

Where \( TCOST = \) total costs of child restraints in use in 1987

\( A \) = number of infant lives saved in 1987

\( a \) = life expectancy of an infant in 1987

\( B \) = number of toddler lives saved in 1987

\( b \) = life expectancy of a toddler in 1987

\( C \) = cost per life year saved, and

\( i \) = discount rate (5 percent and 10 percent).
Table 3

Estimated Sales of Infant and Convertible Restraints: 1984-1987

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales of all Restraints Including Boosters (million)</th>
<th>Sales of Infant and Convertible Restraints (million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>3.29</td>
<td>2.53*</td>
</tr>
<tr>
<td>1985</td>
<td>3.79</td>
<td>2.91*</td>
</tr>
<tr>
<td>1986</td>
<td>-</td>
<td>2.95«</td>
</tr>
<tr>
<td>1987</td>
<td>-</td>
<td>2.58</td>
</tr>
</tbody>
</table>

Note
* Based on a 77 percent market share
• Based on sales convertible restraints of 1.80 million

The costs of child restraints in use in 1987 are given in Table 4 (Shew & Dardis, 1995, p. 425). The estimation of the cost per life years saved is given in Table 5. The cost per life years saved is given in the last column, for 5 % it ranges between $18,900 and $30,000. For 10 % discount, it ranges between $41,200 and $65,300. The total cost for 5 % discount is $100.36 million and for 10 % discount is $112.26 million.
Table 4

Total Cost of Child Restraints in Use in 1987

<table>
<thead>
<tr>
<th>Discount Rate %</th>
<th>Year</th>
<th>Price ($)</th>
<th>Annualized Cost ($)</th>
<th>Sales (million)</th>
<th>Total Costs ($ million)</th>
</tr>
</thead>
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<tr>
<td>5</td>
<td>1984</td>
<td>31.79</td>
<td>8.96</td>
<td>2.53</td>
<td>22.67</td>
</tr>
<tr>
<td></td>
<td>1985</td>
<td>30.54</td>
<td>8.61</td>
<td>2.91</td>
<td>25.05</td>
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<tr>
<td></td>
<td>1986</td>
<td>32.73</td>
<td>9.23</td>
<td>2.95</td>
<td>27.23</td>
</tr>
<tr>
<td></td>
<td>1987</td>
<td>34.93</td>
<td>9.85</td>
<td>2.58</td>
<td>25.41</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>100.36</strong></td>
</tr>
<tr>
<td>10</td>
<td>1984</td>
<td>31.79</td>
<td>10.03</td>
<td>2.53</td>
<td>25.37</td>
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<tr>
<td></td>
<td>1985</td>
<td>36.54</td>
<td>9.63</td>
<td>2.91</td>
<td>28.02</td>
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<tr>
<td></td>
<td>1986</td>
<td>32.73</td>
<td>10.32</td>
<td>2.95</td>
<td>30.44</td>
</tr>
<tr>
<td></td>
<td>1987</td>
<td>34.93</td>
<td>11.02</td>
<td>2.58</td>
<td>28.43</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>112.26</strong></td>
</tr>
</tbody>
</table>

**Note:** From "An Economic Analysis of Child Restraints" by R. Shew and R. Dardis Journal of Consumer Policy, 1995, p 417-431

Table 5

Cost Per Life Year Saved Due to Child Restraints in 1987

<table>
<thead>
<tr>
<th>Discount Rate (%)</th>
<th>Toddler Restraint Effectiveness* (%)</th>
<th>Total Cost ($ million)</th>
<th>Number of Lives Saved</th>
<th>Number of DLY•</th>
<th>Cost per Life Year Saved ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>47</td>
<td>100.36</td>
<td>172</td>
<td>3,345</td>
<td>30,003</td>
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<td>66</td>
<td>100.36</td>
<td>273</td>
<td>5,306</td>
<td>18,914</td>
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<td>10</td>
<td>47</td>
<td>112.26</td>
<td>172</td>
<td>1,718</td>
<td>65,343</td>
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<td>66</td>
<td>112.26</td>
<td>273</td>
<td>2,727</td>
<td>41,166</td>
</tr>
</tbody>
</table>

**Note:**

* Effectiveness of infant restraints was 69 percent
• Discounted life years

Statement of the Hypothesis

The increased number of injuries and fatalities to infants and children during turbulence and crash landing is a significant issue that deserves special attention. The literature suggests that the design and use of an integrated safety seat, the incidents involving infants and children can be significantly reduced. The only major hindrance to this implementation is thought the additional cost to the passenger. It is hypothesized that the flying public are willing to pay for the use of a child restraint seat for infants and children under the age of two years.
Method

Subjects

The population for this study included parents of children/infants under 40 inches tall, or under 40 pounds. Traveling on all types of commercial aircraft departing out of Orlando International Airport. Included in the population were all classes, first and coach/economy class passengers traveling with children/infants. For this study, 115 participants were interviewed. The sample was selected at random, to acquire an accurate representation of the population. Sampling error expected in the study included passengers in the United States only and a limited number of airports. The passengers do not necessarily represent the entire population since the sampling was limited to U.S. travelers only.

Sampling bias may also have been encountered as the subjects were conveniently sampled. It was extremely difficult to select at random and recognize the entire population of parents of children/infants. Sampling bias may also have been experienced due to the volunteers being selected for the study. However, it was assumed that the sample group represented a viable cross section of the population of the infants/children’s parents flying from a U.S. airport.
**Instrument**

The instrument utilized in this study to interview parents was self-developed, especially for this study and to complete it, in the presence of the researcher. The survey was for parents who fly with children/infants under the age of two. The specific purpose of the survey was to gather data to evaluate the proposed hypothesis. Appendix C provides a copy of the survey.

The researcher administered a pretest to a selected group of Embry-Riddle Aeronautical University graduate students, who were considered to be knowledgeable of the topics of the hypothesis. This provided a test of the survey applicability concerning the related subject matter. The result of the pretest was carefully analyzed and evaluated for relevance to the hypothesis. The survey was further modified to better accommodate the required preset goals.

Questions 1 through 3 are designed to provide general information from the participants. Questions 4 and 5 ask the participants to state if parents use any safety seat for their infants/children when traveling on an airplane. The next two questions, 6 and 7 are designed to determine if parents purchase a seat for their infant/child, and how much they are willing to pay, if they are required to purchase a ticket for their infant/child. Question 8 asks if parents consider the overall safety of their infant/child while traveling by commercial airplane. Question 9 asks if parents would purchase a seat, if there were a seat designed just for their infant/child. The last two questions ask parents about using a car seat and if yes, is it approved for use in commercial aircraft?
Design

The research method used in this study was the descriptive method as outlined in the textbook, *Educational Research*, by Gay (1996). Also, a research of comparing the feasibility of using an integrated child and infant safety seat in automobiles for aircraft was conducted. A descriptive study involves the collection of data in order to test the hypotheses or to answer questions concerning the current status of the subject of the study. Descriptive data are usually collected through a questionnaire survey, interviews, or observation.

This study method of research was chosen because of the nature of activity under study and it involves narrative data rather than extensive numerical data. The researcher collected and analyzed past data on the subject of restraint systems for children and infants on commercial aircraft, as well as, collected and analyzed data to supplement the study. The critical variable that was controlled is by whom the survey will be completed.

Procedure

A survey was developed with an adequate content to study the acceptance or the effect of an integrated safety seat on commercial aircraft to reduce or eliminate injuries and fatalities to children and infants. The researcher conducted a student study of the instrument validity utilizing Embry-Riddle Aeronautical University graduate students who are considered to be knowledgeable in the subject of child/infant safety systems on aircraft. After the validity of the questionnaire had been verified, the questionnaire was presented to parents, through personal interviews at the Orlando International Airport, the
selection of parents was redundant. The content of the questionnaire included the participant's level of awareness on the topic of child and infant restraint systems on commercial aircraft and possible solutions to the problem. It was the intent of the researcher to find out as part of the study, the interest level of the existence of an integrated safety seat for children and infant onboard commercial aircraft. Another aspect of the study was to determine how much parents were willing to pay for a seat that is suitable for their children/infants.

The questionnaires were completed by using random sampling techniques to select proportional representation to the study and thus, no sampling bias was encountered during the study. The results of the questionnaire were carefully analyzed and evaluated as outlined in the statistics text written by Elzey (1971), also, using Statistics Package for Social Sciences (SPSS) for analysis. The final results were compared to the hypothesis and conclusions were developed.
Analysis

The analysis of the results is the survey that is presented to the participants. Data were collected from this survey and analyzed using the traditional statistics of chi-square as outlined in *A Programmed Introduction to Statistics* by Elzy (1979).

**Question 1**

*How many children do you have? 1 2 3 4 ————*

This question was designed to gather information about the number of children that the participants had. The response frequencies were distributed among the options as follows: one child-44 (38.3%), two children-61 (53%), three children-8 (7%), four children-1 (0.9%), and five children-1 (0.9%). Appendix D provides a complete listing of participant’s responses. Figure 1 gives a graphic representation of the data distribution. The most favored response (mode) was 2 (two children) with a frequency of 61. The 1 and 2 (one and two children) response options accounted for 91.3% of all participants responses received.
Figure 3. Data Distribution- Question 1.

When performing a chi-square test for question 1, the calculated chi-square was 133.826. The critical value of chi-square for both $p=.05$ and $p=.01$ with df=4 is not as large as either of the two chi-square values listed in the critical table, therefore, the observed differences among the number of children is a non-significant.
**Question 2**

*What are the ages of your children?*

- **0-10 months**
- **11-23 months**
- **24 months and older**

The purpose of question two was to collect data about the ages of the children. The response frequency was distributed among the responses options as follows: for 1 child, 0-10 months-40 (34.8%), 11-23 months-59 (51.3%), 24 months and older-16 (13.9%), for 2 children, 11-23 months-1 (0.9%), 24 months and older-68 (59.1%), for 3 children, 24 months and older-9 (7.8%), for 4 and 5 children-2 (1.7%).

Figure 4 gives a graphic representation of the data distribution for participants with 1 child. The most favored response (mode) was 11-23 months with frequency of 59. The 0-10 months and 11-23 months response option for 1 child accounted for 86.1% of all participants responses received.

![Figure 4. Data Distribution for 1 child-Question 2](image-url)
Figure 5 gives a graphic representation of the data distribution for participants with two children. The most popular response (mode) was 24-months and older with frequency of 68. The 24 months and older response option accounted for 59.1% of all subject responses received.

Figure 6 gives a graphic representation of the data distribution for participants with 3 children. The most popular response (mode) was not applicable (due to the fact that most participants did not have more than two children) with a frequency of 106. The not applicable response option accounted for 92.2% of all subject responses received.
Figure 6: Data Distribution for 3 children-Question 2.

Figure 7 gives a graphic representation of the data distribution for participants with four and five children. The most popular response (mode) was not applicable (due to the fact that most participants did not have more than three children) with a frequency of 113. The not applicable response option accounted for 98.3% of all subject responses received.
Figure 7. Data Distribution for 4 and 5 children-Question 2.

Question 3

Have you ever traveled by commercial aircraft with your children?

Yes  No

This question was designed to check if the participants traveled with their children on commercial aircraft. The response frequencies were distributed among the two responses options as follows: Yes-107 (93%), No-8 (7%). Appendix E provides a complete listings of subject responses. The null hypothesis for this question was "Not too many participants (parents) traveled with their children on commercial aircraft."
Figure 8 gives a graphic representation of the data distribution. The most popular response (mode) was Yes with a frequency of 107. The Yes response option accounted for 93% of all participant responses received.

Figure 8. Data Distribution- Question 3

When performing a chi-square test for question 3, the calculated chi-square was 85.226. The critical value of chi-square for both $p=0.05$ and $p=0.01$ with df=1 is not as large the calculated value for the two chi-square values listed in the critical table, therefore, the observed differences among the number of parents traveling with their children is significant beyond the .01 level. Because the obtained chi-square of 85.226 is larger than is required for significance at the .01 level, the hypothesis that there is no different between the frequency in the “yes”
and "no" categories is rejected. On the basis of the rejection of the null hypothesis at the .01 level, conclude that in the population from which this sample was selected, most participants did travel with their children on commercial aircraft.

**Question 4**

*When traveling on commercial airplane, do you use a certified child safety seat?*  
Yes  No

This question addresses if the participant uses a certified child/infant safety seat, when traveling on commercial aircraft. The response frequencies were distributed among the two options as follows: Yes-55 (47.8%), No-52 (45.2%). Appendix E provides a complete listing of participant responses. The null hypothesis for this question was “participants did not use a certified child safety seat for their infants/children.” Figure 9 gives a graphic representation of the data distribution. The most popular response (mode) was Yes with a frequency of 55.
When performing a chi-square test for question 4, the calculated chi-square was .084. The critical value of chi-square for both $p = .05$ and $p = .01$ with $df = 1$ is not larger than the calculated value for the two chi-square values listed in the critical table, therefore, the observed differences among the number of parents that used a certified child/infant safety seat is not significant beyond the .01 level. Because of the obtained chi-square of .084 is smaller than is required for significance at the .01 level, the hypothesis that there is no different between the frequency in the “yes” and “no” categories is accepted. By accepting the null hypothesis, it concludes that the observed difference in the frequencies among the categories is due to sampling error. Most parents (47.8%) did use a certified child safety seat for their infants and children when traveling on commercial aircraft.
Question 5

Did the airline personnel suggest that you use a safety seat or child restraint system for your child? Yes No

This question was designed to know whether or not airline personnel suggested to the participants to use any form of child restraint system for their infants/children. The response frequencies were distributed among the two response options as follows: Yes-10 (8.7%), No-96 (83.5%). Appendix E provides a complete listing of participant responses. The null hypothesis for this question was "The airline personnel did not suggest to the participants to use a certified child/infant safety seat for their infants and children." Figure 10 gives a graphic representation of the data distribution. The most favored response (mode) was No with a frequency of 96.

Figure 10. Data Distribution—Question 5
When performing a chi-square test for question 5, the calculated chi-square was 69.774. Because the calculated chi-square of 69.774 is larger than either of the two chi-square values for $p=.05$ and $p=.01$ listed in the critical values of chi-square, that conclude that the difference between the frequencies in the two categories is significant beyond the .01 level. Since the calculated chi-square of 69.774 is larger than is required for significant at the .01 level, the hypothesis that there is no difference between the frequencies in the “yes” and “no” categories is rejected. On the basis of the rejection of the null hypothesis at the .01 level, concludes that in the population from which this sample was selected, most people did not receive suggestions from the airline personnel.

**Question 6**

*When traveling on commercial airplane, do you purchase a ticket (for a seat) for your child? Yes No*

Question 6 asks the participants if they purchase a seat for their child that is under the age of two. What is interesting to note here, is that the number of parents that are purchasing the tickets (44.3%) is close to the parents who do not purchase tickets for their infants/children (48.7%). The response frequencies were distributed among the two response options as follows: Yes-51 (44.3%), No-56 (48.7%), and Missing-9 (7.8%). The missing values indicate that the participants either did not answer the question or the question did not apply to him/her. Appendix E provides complete listings of subject responses. The null hypothesis for this question was “when traveling on commercial aircraft
participants did not purchase a ticket for their infants/children. Figure 11 gives a
graphic representation of the data distribution. The most favored response
(mode) was No with a frequency of 56.

Figure 11. Data Distribution-Question 6

When performing a chi-square test for question 6, the calculated chi-
square was .234. The critical value of chi-square for both \( p= 0.05 \) and \( p=0.01 \) with
df=1 is larger than the calculated value two chi-square values listed in the critical
table, therefore, the observed differences among the number of parents that
purchase a seat for their infants/children is not significant beyond the .01 level.
Because of the obtained chi-square of .234 is smaller than is required for significance at the .01 level, the hypothesis that there is no different between the frequency in the “yes” and “no” categories is accepted. By accepting the null hypothesis, the observed differences in the frequency among the categories is due to sampling error.

**Question 7**

*If you were required to purchase a ticket for your child to fly on a commercial airplane, how much would you be willing to pay?*

A. I am willing to pay the same price for my seat and my child’s seat.

B. I am willing to pay 75% of the price of my seat for my child’s seat.

C. I am willing to pay 50% of the price of my seat for my child’s seat.

D. I am not willing to pay for my child to have his/her own seat(s).

Question 7 was designed to show how much the participants (parents) are willing to pay for their infants/children. What is interesting to note here, is that 54.8% of the participants were willing to pay 50% of the price of an adult ticket for their infants/children. On the other hand, question 6 asked the participants if they purchase a ticket for their infants/children, and the results from this question was 44.3% did purchase a ticket for their infants/children. The null hypothesis for this
question was “Participants are not willing to pay to purchase a ticket for their infants and children if they are required to purchase one”.

The response frequencies were distributed among the four response options as follows: Willing to pay same as an adult ticket-36 (31.1%), Willing to pay 75% of an adult ticket-3 (2.6%), Willing to pay 50% of an adult ticket-63 (54.8%), and Not willing to pay-13 (11.3%). The most favored response (mode) was Willing to pay 50% of an adult ticket with frequency of 63. The willing to pay same as an adult ticket and willing to pay 50% of an adult ticket response options accounted for 85.9% of all participants responses received. Appendix E provides a complete listing of subject responses. Figure 12 gives a graphic representation of the data distribution.

Figure 12. Data Distribution-Question 7
In order to test the null hypothesis utilizing the Kolmogorov-Smirnov one-Sample Test, an expected theoretical cumulative frequency distribution had to be calculated. This resulted in the expected frequency for each option to be the total number of participants divided by four. With a total of 115 participants interviewed, the expected frequency for each option was 28.8. The Kolmogorov-Smirnov One Sample Test (the largest difference (in absolute) between the observed and theoretical cumulative distribution functions) was (Z) 3.822. This value is higher than that listed for p=.05 which indicate that the difference between the observed frequencies and expected frequencies was significant at p=.05 and not due to sampling error. This called for a rejection of the null hypothesis that the participants are not willing to pay to purchase a seat for their infants/children.

**Question 8**

_Have you ever considered the overall safety of your child/infant while traveling by commercial aircraft?_  
**Yes**  **No**

Question 8 addresses if the participants are considering the safety of their children while traveling by commercial aircraft. The response frequencies were distributed among the two response options as follows: Yes-111- (96.5%), No-4 (3.5%). Appendix E provides a complete listing of participant responses. The null test hypothesis for this question was “Participants do not consider the overall safety of their infants/children.” Figure 13 gives a graphic representation of the
data distribution. The most favored response (mode) was Yes with a frequency of 111.

![Bar Chart: Data Distribution-Question 8](image)

**Figure 13.** Data Distribution-Question 8

When performing a chi-square test for question 8, the calculated chi-square was 99.557. The critical value of chi-square for both $p=0.05$ and $p=0.01$ with $df=1$ is not as large as either of the two chi-square values listed in the critical table, therefore, the observed differences among participants (parents) that consider the overall safety of their infants and children is significant beyond the .01 level. Because of the obtained chi-square of 99.557 is larger than is required for significant at the .01, the hypothesis that there is no different between the frequency in the “yes” and “no” categories is rejected. On the basis of the rejection of the null hypothesis at the .01 level, concludes that in the population
from which this sample was selected, most participants did consider the overall safety of their infants and children.

**Question 9**

*If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for your child/infant to be seated in such a seat (the child/infant seat located in proximity to your own)? Yes No*

Question 9 gathered information concerning the design of an infant/child seat. Also, it addresses if the parents are willing to purchase a seat that is designed specially for their infants and children. The response frequencies were distributed among the two-response option as follows: Yes-99 (86.1%), No-16 (13.9%). The most favored answered (mode) was Yes with a frequency of 99.

Appendix E provides a complete listings of subject responses. The null hypothesis for this question was *“Participants are not willing to purchase a ticket for a seat that is designed specially for their infants/children.”* Figure 14 gives a graphic representation of the data distribution.
When performing a chi-square test for question 9, the calculated chi-square was 59.904. The critical value of chi-square for both $p=0.05$ and $p=0.01$ with df=1 is not as large as either of the two chi-square values listed in the critical table, therefore, the observed differences among the participants (parents) they will purchase a ticket for a seat designed for their infant/child is significant beyond the .01 level. Because of the obtained chi-square of 59.904 is larger than is required for significant at the .01, the hypothesis that there is no different between the frequency in the “yes” and “no” categories is rejected. On the basis of the rejection of the null hypothesis at the .01 level, concludes that in the population from which this sample was selected, most participants are willing to purchase a seat for their infants and children if there were a special seat (integrated safety seat) designed just for them.
Question 10

Do you have a car seat for your child/infant? Yes No

Question 9 was designed to inquire about whether or not the participants have a car seat for their infants and children. The response frequencies were distributed among the two response options as follows: Yes-112 (97.4%), No-3 (2.6%). It is interesting to note here, that almost all the participants did have a car seat for their infants/children. Appendix E provides a complete listing of subject responses. Figure 15 gives a graphic representation of the data distribution. The null hypothesis for this question was “Participants do not own car seats for their infants/children.” The most popular response was Yes with a frequency of 112.
When performing a chi-square test for question 10, the calculated chi-square was 103.313. The critical value of chi-square for both $p=.05$ and $p=.01$ with $df=1$ is not as large as either of the two chi-square values listed in the critical table, therefore, the observed differences among the participants (parents) that they have car seats for their infants and children is significant beyond the .01 level. Because of the obtained chi-square of 103.313 is larger than is required for significant at the .01, the hypothesis that there is no different between the frequency in the “yes” and “no” categories is rejected. On the basis of the rejection of the null hypothesis at the .01 level, concludes that in the population from this sample was selected, most participants do have car seats for their infants/children.

**Question 11**

*If you do presently own a car seat, is it approved for use in Aircraft?*

Yes No I don’t know

Question 11 is a continuation of question 10, and it asks the participants if the car seat that they won is approved for use in aircraft. The response frequencies were distributed among the three response potions as follows: Yes-47 (40.9%), No-4- (3.5%), and I don’t know-64 (55.7%). Appendix E provides a complete listing of subject responses. Figure 15 gives a graphic representation of the data distribution. The most popular response (mode) was I don’t know with a frequency of 64. The null hypothesis for this question was “*Car seats that are presently owned by the participants are not approved for use in aircraft.*”
Figure 16. Data Distribution-Question 11.

When performing a chi-square test for question 11, the calculated chi-square was 49.896. The critical value of chi-square for both $p=.05$ and $p=.01$ with $df=2$ is not as large as the calculated value for the two chi-square values listed in the critical table, therefore, the observed difference among parents who own a car seat that is approved for use in commercial aircraft is significant beyond the .01 level. Because the obtained chi-square of 49.896 is larger than is required for significance at the .01 level, the hypothesis that there is no different between the frequency in the "yes", "no", and "I don't know" categories is rejected. On the
basis of the rejection of the null hypothesis at the .01 level, conclude that in the population from which this sample was selected the most participants did not know if the car seat that they own, is or is not approved for use in commercial aircraft.
Conclusions

The purpose of the study was to investigate the financial feasibility of an integrated safety seat for infants and children under the age of two onboard commercial aircraft. This study was based on past research efforts addressing the current infants/children safety systems and its effectiveness in commercial aircraft. The conclusions that follow are based on the data gathered during the research process.

The researcher reviewed the FARs up to January of 1998, to analyze the issue of child restraint systems that are currently in use in commercial aircraft. Comparing the FARs with FMVSS 213 was also studied in this research. In addition, the researcher interviewed personally 115 parents, to view their opinion about the design of an integrated child safety seat. Question 3 shows that 93% of parents traveled with their children on commercial aircraft. Almost 35% of the children were under 10 month old infants, and over 51% were between the age of 11 month and 23-month old children. The data collected for the purpose of this research shows that over 86% of infants and children flying on commercial aircraft are under the age of two. Question 5 shows that over 83% of parents were not advised by the airline’s personnel to use a safety seat for their infants or children.

In question 7, almost 55% of parents were willing to pay 50% of an adult ticket, almost 3% were willing to pay 75% of an adult ticket, and over 31% were
willing to pay full price ticket for their children. This data concludes that over 98% are willing to pay at least 50% of a regular ticket, and that is the price of a child over 2 years old ticket. That is the price that parents of a child over 2 years old must pay when traveling on commercial aircraft. Finally, question 9 shows that 86% of the parents were willing to purchase a seat if there were a seat designed (integrated safety seat) to accommodate their children/infant's needs. When comparing Child Restraint Systems between the FAR 25.562 and the FMVSS-213 it appears to the researcher that the FAR 25.562 use the English system where FMVSS-213 uses the Metric system. Therefore, there should be a margin of error when converting the units between the English system and metric system and visa versa. This error would be carried out through out all calculations that FAR 25.562 and the FMVSS-213 conduct. It also appeared to the researcher that when designing a safety car seat meeting all FMVSS-213 specifications that does not mean it meet FAR 25.562 standards, because the forces and its magnitude in cars are different than those in airplanes.

In summary, a review of most of the Federal Aviation Regulations, and previous tests concerning Child Restraint Systems issues have led the researcher to conclude that there is a need and market for CRSs in commercial aircraft. The present CRS is not an effective restraint to protect infants/children. The data shows that the parents/guardians believe an integrated safety seat for infants/children under the age of two is an absolute request that must be addressed by the FAA and the commercial airlines to reduce the chances of injuries and fatalities to their infants children if not prevent them. The
researcher's objective was to provide some basis and direction for further research studies. For that purpose, the following section provides a non-exclusive list of recommendations.
Recommendations

Recommendations for the issue of child restraint systems

The following recommendations were drawn from several sources:

1. The review of the literature concerning child safety on board commercial aircraft.

2. The data collected by the researcher for this study.

3. The research found out some safety issues other than child safety seat issues that need special attention, such as the safety of flight attendants.

From engineering and a safety point of view, the design for a child restraint system must be considered as a primary issue to the FAA. For the purpose of achieving this, the following recommendations are made for the design of an integrated safety seat:

1. Establish the design for the child/infant seat, especially for commercial aircraft, considering all the forces that apply to the child/infant and the seat.

2. The location of the child safety seat is important. Also the location of the integrated safety seat may not require to occupy another passenger seat. For example, the integrated safety seat could be located in front of the parent, not necessary occupying a seat.
3. The FAA should fund projects that promote safety, especially child safety seats on board commercial aircraft. Additionally, the FAA should be responsible for making sure that the airlines implement the most up to date safety regulations.

**Recommendations for Further Research**

The following recommendations are made in order to provide some guidance for further research in the area of cabin safety:

1. A study should be conducted to evaluate the safety of flight attendants.
2. A study should be conducted to measure the performance of up-to-date child restraint systems.
3. Designing a child/infant seat for use in commercial aircraft.
4. A study concerning the airlines awareness of the FARs.
References

Akey, P. R. (1998). A study to determine if flight attendants perceive a child safety restraints system mandate would reduce the number of in-flight turbulence-related injuries to infants under the age of 2. Master’s GRP. Embry-Riddle Aeronautical University, Extended Campus, MacDill AFB Resident Center.


Federal Aviation Administration. (1978, March). Child restraint systems for civil aircraft. FAA-AM-12, (p. 3).


H.R. 4025: To amend the Federal Aviation Administration Act of 1985 to require the use of child safety restraint systems approved by the Secretary of Transportation on Commercial aircraft: Hearing before the Subcommittee on Aviation of the Committee on Public Works and Transportation, House of Representatives, 101st Cong., 2nd Sess.1 (1990, July 12).


Appendix A

Senate Bill (s)
H. R. 754

To amend title 49, United States Code, to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft.

IN THE HOUSE OF REPRESENTATIVES

February 13, 1997

Mr. DeFazio (for himself, Mr. Shays, Mr. Conyers, Mr. Hinchey, Mr. Filner, Mrs. Morella, Mr. Abercrombie, Mr. Nadler, Mr. Evans, Mr. Horn, Ms. Woolsey, Mr. Blagojevich, Ms. Norton, Ms. Jackson-Lee of Texas, Mr. Rahall, Mrs. Carson, Mrs. Maloney of New York, Mr. Mascara, Mr. Flake, Mr. Gonzalez, Mrs. Clayton, Mr. Lantos, Ms. Pelosi, and Mr. Dan Schaefer of Colorado) introduced the following bill; which was referred to the Committee on Transportation and Infrastructure

A BILL

To amend title 49, United States Code, to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1 CHILD RESTRAINT SYSTEMS ON COMMERCIAL AIRCRAFT.

(a) In General.--Chapter 447 of title 49, United States Code, is amended by adding at the end the following new section:

''Sec. 44725. Child restraint systems

''Not later than 90 days after the date of the enactment of this section, the Secretary shall issue regulations requiring the use of child safety restraint systems approved by the Secretary on any aircraft operated by an air carrier in providing interstate air transportation, intrastate transportation, or overseas air transportation. Such regulations shall establish age or weight limits for children who are to use such systems.''.

(b) Clerical Amendment.--The table of sections at the beginning of such chapter is amended by adding at the end the following new item:

''44725. Child restraint systems.''.

SEC. 2. INTERNATIONAL STANDARD.
It is the sense of Congress that the United States representative to the International Civil Aviation Organization should seek an international standard to require that passengers on a civil aviation aircraft be restrained on takeoff and landing and when directed by the captain of such aircraft.
To amend title 49, United States Code, to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft, and for other purposes.

IN THE SENATE OF THE UNITED STATES

March 5, 1997

Mrs. Murray introduced the following bill, which was read twice and referred to the Committee on Commerce, Science, and Transportation

A BILL

To amend title 49, United States Code, to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. CHILD SAFETY RESTRAINT SYSTEMS ON COMMERCIAL AIRCRAFT.

(a) In General --Chapter 447 of title 49, United States Code, is amended by adding at the end the following new section:

Sec. 44725. Child safety restraint systems.

(a) In General --Not later than 90 days after the date of enactment of this section, the Secretary of Transportation shall issue regulations requiring the use of child safety restraint systems that have been approved by the Secretary on any aircraft operated by an air carrier in providing interstate air transportation, intrastate air transportation, or foreign air transportation.

(b) Age or Weight Limits --The regulations issued under this section shall establish age or weight limits for children who use the child safety restraint systems.

(b) Clerical Amendment.--The chapter analysis for chapter 447 of title 49, United States Code, is amended by adding at the end the following new item:

'44725. Child safety restraint systems.'.

SEC. 2. INTERNATIONAL STANDARD.

It is the sense of Congress that the United States representative to the International Civil Aviation Organization should seek an
international standard to require that passengers on a civil aviation aircraft be restrained--
(1) on takeoff and landing; and
(2) when directed by the captain of such aircraft.
<all>
105th CONGRESS
1st Session
H. R. 1141

To amend title 49, United States Code, to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft and to restrict the fares charged by air carriers for air transportation provided to children under 3 years of age.

IN THE HOUSE OF REPRESENTATIVES
March 20, 1997

Mr. DeFazio introduced the following bill, which was referred to the Committee on Transportation and Infrastructure

A BILL

To amend title 49, United States Code, to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft and to restrict the fares charged by air carriers for air transportation provided to children under 3 years of age.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1 CHILD RESTRAINT SYSTEMS ON COMMERCIAL AIRCRAFT

(a) In General --Chapter 447 of title 49, United States Code, is amended by adding at the end the following new section

'"Sec. 44725 Child restraint systems."

Not later than 90 days after the date of the enactment of this section, the Secretary shall issue regulations requiring the use of child safety restraint systems approved by the Secretary on any aircraft operated by an air carrier in providing interstate air transportation, intrastate transportation, or overseas air transportation. Such regulations shall establish age or weight limits for children who are to use such systems.''.

(b) Clerical Amendment --The table of sections at the beginning of such chapter is amended by adding at the end the following new item:

'"44725. Child restraint systems.''.

SEC 2. AIR TRANSPORTATION PRICES FOR CHILDREN UNDER 3 YEARS OF AGE

(a) Maximum Price.--

(1) In general.--Chapter 415 of title 49, United States Code, is amended by adding at the end the following new
Sec. 41512. Air transportation prices for children under 3 years of age

(a) In General.--An air carrier providing air transportation to a child under 3 years of age on a scheduled flight to any final destination may not charge a price for such air transportation that exceeds the lowest price charged by the air carrier for such air transportation to any other paying passenger on such flight with the same final destination.

(b) Definitions.--In this section, the following definitions apply:

(1) Air carrier.--The term 'air carrier' includes foreign air carriers.

(2) Air transportation.--The term 'air transportation' includes intrastate air transportation.''.

(2) Clerical amendment.--The table of sections at the beginning of such chapter is amended by adding at the end the following new item:

41512. Air transportation prices for children under 3 years of age.''.

(b) Sense of Congress.--It is the sense of Congress that air carriers should provide air transportation to children under 3 years of age at no charge.
To amend title 49, United States Code, to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft, and for other purposes.

IN THE SENATE OF THE UNITED STATES

September 27, 1996

Mrs. Murray introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

A BILL

To amend title 49, United States Code, to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. CHILD SAFETY RESTRAINT SYSTEMS ON COMMERCIAL AIRCRAFT.

(a) In General.--Chapter 447 of title 49, United States Code, is amended by adding at the end the following new section:

Sec. 44724. Child safety restraint systems 

'(a) In General.--Not later than 90 days after the date of the enactment of this section, the Secretary of Transportation shall issue regulations requiring the use of child safety restraint systems that have been approved by the Secretary on any aircraft operated by an air carrier in providing interstate air transportation, intrastate air transportation, or foreign air transportation.

'(b) Age or Weight Limits.--The regulations issued under this section shall establish age or weight limits for children who use the child safety restraint systems.''.

(b) Clerical Amendment.--The chapter analysis for chapter 447 of title 49, United States Code, is amended by adding at the end the following new item:

'44724. Child safety restraint systems.''.

SEC. 2. INTERNATIONAL STANDARD.

It is the sense of the Congress that the United States representative to the International Civil Aviation Organization should
seek an international standard to require that passengers on a civil aviation aircraft be restrained--
(1) on takeoff and landing; and
(2) when directed by the captain of such aircraft.
To amend title 49, United States Code, to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft.

IN THE HOUSE OF REPRESENTATIVES

March 23, 1995

Mr. Lightfoot (for himself, Mr. Lazio of New York, Mr. Clinger, Mr. Dornan, Mr. Lantos, Mrs. Meek of Florida, Mrs. Maloney, Mr. Nadler, Mr. Rahall, Mr. Schaefer, Mr. Shays, Mr. Stark, Mr. Vento, Mr. Weldon of Florida, and Mr. Wynn) introduced the following bill; which was referred to the Committee on Transportation and Infrastructure

A BILL

To amend title 49, United States Code, to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. CHILD RESTRAINT SYSTEMS ON COMMERCIAL AIRCRAFT.

(a) In General.—Chapter 447 of title 49, United States Code, is amended by adding at the end the following new section:

``Sec. 44724. Child restraint systems

Not later than 90 days after the date of the enactment of this section, the Secretary shall issue regulations requiring the use of child safety restraint systems approved by the Secretary on any aircraft operated by an air carrier in providing interstate air transportation, intrastate transportation, or overseas air transportation. Such regulations shall establish age or weight limits for children who are to use such systems.''

(b) Clerical Amendment.—The table of sections at the beginning of such chapter is amended by adding at the end the following new item:

``44724. Child restraint systems.''

SEC. 2. INTERNATIONAL STANDARD.

It is the sense of Congress that the United States representative to the International Civil Aviation Organization should seek an
international standard to require that passengers on a civil aviation aircraft be restrained on takeoff and landing and when directed by the captain of such aircraft.

<all>
To amend the Federal Aviation Act of 1958 to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft.

IN THE HOUSE OF REPRESENTATIVES
March 30, 1993

Mr. Lightfoot (for himself, Mrs. Unsoeld, Mr. de Lugo, Mr. Vento, Mr. Jacobs, Mr. Shays, Mr. Ackerman, Mr. Clinger, Mr. Frost, Ms. Norton, Mr. Wynn, Mr. Lantos, Mr. McDermott, Mr. Filner, Mr. Leach, Mrs. Meek, Mr. Fish, Mrs. Maloney, Mr. Towns, Mr. Romero-Barcelo, Mr. Lazio, Ms. Roybal-Allard, Ms. Kaptur, and Mr. Hancock) introduced the following bill; which was referred to the Committee on Public Works and Transportation

A BILL

To amend the Federal Aviation Act of 1958 to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. CHILD RESTRAINT SYSTEMS ON COMMERCIAL AIRCRAFT.

(a) In General.--Section 601 of the Federal Aviation Act of 1958 (49 U.S.C. App. 1421) is amended by adding at the end the following new subsection:

''(g) Child Restraint Systems.--Not later than 90 days after the date of the enactment of this subsection, the Secretary shall issue regulations requiring the use of child safety restraint systems approved by the Secretary on any aircraft operated by an air carrier in providing interstate air transportation, intrastate transportation, or overseas air transportation. Such regulations shall establish age or weight limits for children who are to use such systems.''.

(b) Conforming Amendment.--The table of contents contained in the first section of such Act is amended by inserting at the end of the matter relating to section 601 the following new item:

''(g) Child restraint systems.''.

SEC. 2. INTERNATIONAL STANDARD.

It is the sense of Congress that the United States representative to the International Civil Aviation Organization should seek an
international standard to require that passengers on a civil aviation aircraft be restrained on takeoff and landing and when directed by the captain of such aircraft.
H.R. 754--A bill to amend title 49, United States Code, to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft; to the Committee on Transportation and Infrastructure.

Cosponsors added, H678 [26FE], H1550 [25MR], H2706 [30AP], H3247 [13MY], H3488 [19MY], H5593 [15JY], H6820 [30JY]
H.R. 1309--A bill to amend title 49, United States Code, to require
the use of child safety restraint systems approved by the
Secretary of Transportation on commercial aircraft; to the
Committee on Transportation and Infrastructure.

By Mr. LIGHTFOOT (for himself, Mr. Lazio of New York, Mr. Clinger,
Mr. Dornan, Mr. Lantos, Mrs. Meek of Florida, Mrs. Maloney, Mr.
Nailer, Mr. Rahall, Mr. Schaefer, Mr. Shays, Mr. Stark, Mr. Vento,
Mr. Weldon of Florida, and Mr. Wynn), H3732 [23MR]
Cosponsors added, H4415 [6AP], H7179 [18JY], H7990 [28JY], H11686
[1NO]
Cosponsors added, H9566 [31JY], H11048 [24SE]
H.R. 1533--A bill to amend the Federal Aviation Act of 1958 to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft; to the Committee on Public Works and Transportation.

By Mr. LIGHTFOOT (for himself, Mrs. Unsoeld, Mr. de Lugo, Mr. Vento, Mr. Jacobs, Mr. Shays, Mr. Ackerman, Mr. Clinger, Mr. Frost, Ms. Norton, Mr. Wynn, Mr. Lantos, Mr. McDermott, Mr. Filner, Mr. Leach, Ms. Meek, Mr. Fish, Ms. Maloney, Mr. Towns, Mr. Romero-Barcelo, Mr. Lazio, Ms. Roybal-Allard, Ms. Kaptur, and Mr. Hancock), H1738 [30MR]

Cosponsors added, H2817 [25MY], H4278 [29JN], H6902 [22SE]
Cosponsors added, H2582 [20AP]
To require the use of child restraint systems on commercial aircraft.

A BILL

To require the use of child restraint systems on commercial aircraft

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1 CHILD RESTRAINT SYSTEMS ON COMmerCIAL AIRCRAFT

(a) In General --Section 601 of the Federal Aviation Act of 1958 (49 U.S.C. App. 1421) is amended by adding at the end the following new subsection:

(g) Child Restraint Systems --Not later than 90 days after the date of enactment of this subsection, the Administrator shall issue regulations requiring the use of child safety restraint systems approved by the Administrator on air carriers providing interstate air transportation, intrastate air transportation, and overseas air transportation. Such regulations shall establish age or weight limits for children who are to use such systems.

(b) Conforming Amendment --The table of contents contained in the first section of such Act is amended by inserting at the end of the matter relating to section 601 the following new item:

(g) Child restraint systems on commercial aircraft.

SEC. 2. INTERNATIONAL STANDARD

It is the sense of the Congress that the United States representative to the International Civil Aviation Organization should seek an international standard to require that passengers on a civil aviation aircraft be restrained on takeoff and landing and when directed by the captain of such aircraft.
H.R. 2063--A bill to amend the Federal Aviation Act of 1958 to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft; to the Committee on Public Works and Transportation.

By Mr. LIGHTFOOT (for himself, Mr. Roe, Mr. Clinger, Mr. de Lugo, Mr. Shays, Mr. Towns, Mr. Evans, Mr. Horton, Mr. Lagomarsino, Mr. Goodling, Mr. Hunter, Mr. Studds, Mr. Sabo, Mr. Hayes of Illinois, Mrs. Collins of Illinois, Mr. Bilbray, Mr. Dwyer of New Jersey, Mr. Feighan, Mr. Lewis of Georgia, Mr. Jacobs, Mr. McDermott, Mr. Serrano, Mr. Engel, Mr. Smith of New Jersey, Mr. Gejdenson, and Mr. Fish)

Cosponsors added
Cosponsors added
S. 1877--A bill to require the use of child restraint systems on commercial aircraft; to the Committee on Commerce, Science, and Transportation.
By Mr. BOND (for himself, Mr. Danforth, Mr. Grassley, Mr. D'Amato, and Mr. Cranston)
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H.R. 2063--A bill to amend the Federal Aviation Act of 1958 to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft; to the Committee on Public Works and Transportation.

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Cosponsors added
From the 1991 History of Bills Online via GPO Access [wais.access.gpo.gov]

S. 1877--A bill to require the use of child restraint systems on commercial aircraft; to the Committee on Commerce, Science, and Transportation.

By Mr. BOND (for himself, Mr. Danforth, Mr. Grassley, Mr. D'Amato, and Mr. Cranston)

Cosponsors added
S. 1913--A bill to require the use of child restraint systems on commercial aircraft; to the Committee on Commerce, Science, and Transportation.

By Mr. BOND
Cosponsors added
Reported (no written report)
Passed Senate
Referred to the Committee on Public Works and Transportation
H.R. 4025--A bill to amend the Federal Aviation Act of 1958 to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft; to the Committee on Public Works and Transportation.

By Mr. LIGHTFOOT (for himself, Mr. Roe, Mrs. Bentley, Mr. Lancaster, Mr. de Lugo, Mr. Fauntroy, Mr. Shays, Mr. Smith of New Jersey, Mr. Fuster, Mr. Foglietta, Mr. Towns, and Mr. English)

Cosponsors added
Appendix B

Codes of Federal Regulations (CFRs)
Sec. 91.107 Use of safety belts, shoulder harnesses, and child restraint systems.

(a) Unless otherwise authorized by the Administrator--

(1) No pilot may take off a U.S.-registered civil aircraft (except a free balloon that incorporates a basket or gondola, or an airship type certificated before November 2, 1987) unless the pilot in command of that aircraft ensures that each person on board is briefed on how to fasten and unfasten that person's safety belt and, if installed, shoulder harness.

(2) No pilot may cause to be moved on the surface, take off, or land a U.S.-registered civil aircraft (except a free balloon that incorporates a basket or gondola, or an airship type certificated before November 2, 1987) unless the pilot in command of that aircraft ensures that each person on board has been notified to fasten his or her safety belt and, if installed, his or her shoulder harness.

(3) Except as provided in this paragraph, each person on board a U.S.-registered civil aircraft (except a free balloon that incorporates a basket or gondola or an airship type certificated before November 2, 1987) must occupy an approved seat or berth with a safety belt and, if installed, shoulder harness, properly secured about him or her during movement on the surface, takeoff, and landing. For seaplane and float equipped rotorcraft operations during movement on the surface, the person pushing off the seaplane or rotorcraft from the dock and the person mooring the seaplane or rotorcraft at the dock are excepted from the preceding seating and safety belt requirements. Notwithstanding the preceding requirements of this paragraph, a person may:

(i) Be held by an adult who is occupying an approved seat or berth, provided that the person being held has not reached his or her second birthday and does not occupy or use any restraining device;

(ii) Use the floor of the aircraft as a seat, provided that the person is on board for the purpose of engaging in sport parachuting; or

(iii) Notwithstanding any other requirement of this chapter, occupy an approved child restraint system furnished by the operator or one of the persons described in paragraph (a)(3)(iii)(A) of this section provided that:

(A) The child is accompanied by a parent, guardian, or attendant designated by the child's parent or guardian to attend to the safety of the child during the flight;

(B) Except as provided in paragraph (a)(3)(iii)(B)(4) of this action, the approved child restraint system bears one or more labels as follows:

(1) Seats manufactured to U.S. standards between January 1, 1981, and February 25, 1985, must bear the label: "This child restraint
system conforms to all applicable Federal motor vehicle safety standards''; (2) Seats manufactured to U.S. standards on or after February 26, 1985, must bear two labels: (i) "This child restraint system conforms to all applicable Federal motor vehicle safety standards''; and (ii) "THIS RESTRAINT IS CERTIFIED FOR USE IN MOTOR VEHICLES AND AIRCRAFT'' in red lettering; (3) Seats that do not qualify under paragraphs (a)(3)(iii)(B)(1) and (a)(3)(iii)(B)(2) of this section must bear either a label showing approval of a foreign government or a label showing that the seat was manufactured under the standards of the United Nations; (4) Notwithstanding any other provision of this section, booster-type child restraint systems (as defined in Federal Motor Vehicle Safety Standard No. 213 (49 CFR 571.213)), vest- and harness-type child restraint systems, and lap held child restraints are not approved for use in aircraft; and (C) The operator complies with the following requirements: (1) The restraint system must be properly secured to an approved forward-facing seat or berth; (2) The child must be properly secured in the restraint system and must not exceed the specified weight limit for the restraint system, and (3) The restraint system must bear the appropriate label(s). (b) Unless otherwise stated, this section does not apply to operations conducted under part 121, 125, or 135 of this chapter. Paragraph (a)(3) of this section does not apply to persons subject to Sec. 91.105.

Sec. 121.311 Seats, safety belts, and shoulder harnesses.

(a) No person may operate an airplane unless there are available during the takeoff, en route flight, and landing—

(1) An approved seat or berth for each person on board the airplane who has reached his second birthday; and

(2) An approved safety belt for separate use by each person on board the airplane who has reached his second birthday, except that two persons occupying a berth may share one approved safety belt and two persons occupying a multiple lounge or divan seat may share one approved safety belt during en route flight only.

(b) Except as provided in this paragraph, each person on board an airplane operated under this part shall occupy an approved seat or berth with a separate safety belt properly secured about him or her during movement on the surface, takeoff, and landing. A safety belt provided for the occupant of a seat may not be used by more than one person who has reached his or her second birthday. Notwithstanding the preceding requirements, a child may:

(1) Be held by an adult who is occupying an approved seat or berth, provided the child has not reached his or her second birthday and the child does not occupy or use any restraining device; or

(2) Notwithstanding any other requirement of this chapter, occupy an approved child restraint system furnished by the certificate holder or one of the persons described in paragraph (b)(2)(i) of this section, provided:

(i) The child is accompanied by a parent, guardian, or attendant designated by the child's parent or guardian to attend to the safety of the child during the flight;

(ii) Except as provided in paragraph (b)(2)(i)(D) of this section, the approved child restraint system bears one or more labels as follows:

(A) Seats manufactured to U.S. standards between January 1, 1981, and February 25, 1985, must bear the label: "This child restraint system conforms to all applicable Federal motor vehicle safety standards."

(B) Seats manufactured to U.S. standards on or after February 26, 1985, must bear two labels:

(1) "This child restraint system conforms to all applicable Federal motor vehicle safety standards"; and

(2) "THIS RESTRAINT IS CERTIFIED FOR USE IN MOTOR VEHICLES AND AIRCRAFT" in red lettering;

(C) Seats that do not qualify under paragraphs (b)(2)(i)(A) and (b)(2)(i)(B) of this section must bear either a label showing approval of a foreign government or a label showing that the
(D) Notwithstanding any other provisions of this section, booster-type child restraint systems (as defined in Federal Motor Vehicle Standard No. 213 (49 CFR 571.213)), vest- and harness-type child restraint systems, and lap held child restraints are not approved for use in aircraft; and

(iii) The certificate holder complies with the following requirements:
   (A) The restraint system must be properly secured to an approved forward-facing seat or berth;
   (B) The child must be properly secured in the restraint system and must not exceed the specified weight limit for the restraint system; and
   (C) The restraint system must bear the appropriate label(s).

(c) Except as provided in paragraph (c)(3) of this section, the following prohibitions apply to certificate holders:

(1) No certificate holder may permit a child, in an aircraft, to occupy a booster-type child restraint system, a vest-type child restraint system, a harness-type child restraint system, or a lap held child restraint system during take off, landing, and movement on the surface.

(2) Except as required in paragraph (c)(1) of this section, no certificate holder may prohibit a child, if requested by the child's parent, guardian, or designated attendant, from occupying a child restraint system furnished by the child's parent, guardian, or designated attendant provided—
   (i) The child holds a ticket for an approved seat or berth or such seat or berth is otherwise made available by the certificate holder for the child's use;
   (ii) The requirements of paragraph (c)(2)(i) of this section are met;
   (iii) The requirements of paragraph (b)(2)(i) of this section are met; and
   (iv) The child restraint system has one or more of the labels described in paragraphs (b)(2)(i)(A) through (b)(2)(ii)(C) of this section.

(3) This section does not prohibit the certificate holder from providing child restraint systems authorized by this section or, consistent with safe operating practices, determining the most appropriate passenger seat location for the child restraint system.

(d) Each sideward facing seat must comply with the applicable requirements of Sec. 25.785(c) of this chapter.

(e) Except as provided in paragraphs (e)(1) through (e)(3) of this section, no certificate holder may take off or land an airplane unless each passenger seat back is in the upright position. Each passenger shall comply with instructions given by a crewmember in compliance with this paragraph.

(1) This paragraph does not apply to seat backs placed in other than the upright position in compliance with Sec. 121.310(f)(3).

(2) This paragraph does not apply to seats on which cargo or persons who are unable to sit erect for a medical reason are carried in accordance with procedures in the certificate holder's manual if the seat back does not obstruct any passenger's access to the aisle or to any emergency exit.

(3) On airplanes with no flight attendant, the certificate holder may take off or land as long as the flightcrew instructs each passenger to place his or her seat back in the upright position for takeoff and landing.

(f) No person may operate a transport category airplane that was type certificated after January 1, 1958, or a nontransport category airplane manufactured after March 20, 1997, unless it is equipped at each flight deck station with a combined safety belt and shoulder harness that meets the applicable requirements specified in Sec. 25.785 of this chapter, effective March 6, 1980, except that—

(1) Shoulder harnesses and combined safety belt and shoulder
harnesses that were approved and installed before March 6, 1980, may continue to be used; and

(2) Safety belt and shoulder harness restraint systems may be designed to the inertia load factors established under the certification basis of the airplane.

(g) Each flight attendant must have a seat for takeoff and landing in the passenger compartment that meets the requirements of Sec. 25.785 of this chapter, effective March 6, 1980, except that--

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(1) Combined safety belt and shoulder harnesses that were approved and installed before March 6, 1980, may continue to be used; and

(2) Safety belt and shoulder harness restraint systems may be designed to the inertia load factors established under the certification basis of the airplane.

(3) The requirements of Sec. 25.785(h) do not apply to passenger seats occupied by flight attendants not required by Sec. 121.391.

(h) Each occupant of a seat equipped with a shoulder harness or with a combined safety belt and shoulder harness must have the shoulder harness or combined safety belt and shoulder harness properly secured about that occupant during takeoff and landing, except that a shoulder harness that is not combined with a safety belt may be unfastened if the occupant cannot perform the required duties with the shoulder harness fastened.

(i) At each unoccupied seat, the safety belt and shoulder harness, if installed, must be secured so as not to interfere with crew members in the performance of their duties or with the rapid egress of occupants in an emergency.

Sec. 125.211 Seat and safety belts.

(a) No person may operate an airplane unless there are available during the takeoff, en route flight, and landing--
   (1) An approved seat or berth for each person on board the airplane who is at least 2 years old; and
   (2) An approved safety belt for separate use by each person on board the airplane who is at least 2 years old, except that two persons occupying a berth may share one approved safety belt and two persons occupying a multiple lounge or divan seat may share one approved safety belt during en route flight only.

(b) Except as provided in paragraphs (b)(1) and (b)(2) of this section, each person on board an airplane operated under this part shall occupy an approved seat or berth with a separate safety belt properly secured about him or her during movement on the surface, takeoff, and landing. A safety belt provided for the occupant of a seat may not be used for more than one person who has reached his or her second birthday. Notwithstanding the preceding requirements, a child may:
   (1) Be held by an adult who is occupying an approved seat or berth, provided the child has not reached his or her second birthday and the child does not occupy or use any restraining device; or
   (2) Notwithstanding any other requirement of this chapter, occupy an approved child restraint system furnished by the certificate holder or one of the persons described in paragraph (b)(2)(1) of this section, provided:
      (i) The child is accompanied by a parent, guardian, or attendant designated by the child's parent or guardian to attend to the safety of the child during the flight;
      (ii) Except as provided in paragraph (b)(2)(11)(D) of this section, the approved child restraint system bears one or more labels as follows:
         (A) Seats manufactured to U.S. standards between January 1, 1981, and February 25, 1985, must bear the label: 'This child restraint system conforms to all applicable Federal motor vehicle safety standards';
         (B) Seats manufactured to U.S. standards on or after February 26, 1985, must bear two labels:
            (1) 'This child restraint system conforms to all applicable Federal motor vehicle safety standards'; and
            (2) 'THIS RESTRAINT IS CERTIFIED FOR USE IN MOTOR VEHICLES AND AIRCRAFT' in red lettering;
         (C) Seats that do not qualify under paragraphs (b)(2)(11)(A) and (b)(2)(11)(B) of this section must bear either a label showing approval
of a foreign government or a label showing that the seat was manufactured under the standards of the United Nations;
(D) Notwithstanding any other provisions of this section, booster-type child restraint systems (as defined in Federal Motor Vehicle Standard No. 213 (49 CFR 571.213)), vest- and harness-type child restraint systems, and lap held child restraints are not approved for use in aircraft; and
(iii) The certificate holder complies with the following requirements:
(A) The restraint system must be properly secured to an approved forward-facing seat or berth;
(B) The child must be properly secured in the restraint system and must not exceed the specified weight limit for the restraint system; and
(C) The restraint system must bear the appropriate label(s).
(c) Except as provided in paragraph (c)(3) of this section, the following prohibitions apply to certificate holders:
(1) No certificate holder may permit a child, in an aircraft, to occupy a booster-type child restraint system, a vest-type child restraint system, a harness-type child restraint system, or a lap held child restraint system during takeoff, landing, and movement on the surface.
(2) Except as required in paragraph (c)(1) of this section, no certificate holder may prohibit a child, if requested by the child’s parent, guardian, or designated attendant, from occupying a child restraint system furnished by the child’s parent, guardian, or designated attendant provided
   (i) The child holds a ticket for an approved seat or berth or such seat or berth is otherwise made available by the certificate holder for the child’s use;
   (ii) The requirements of paragraph (b)(2)(i) of this section are met;
   (iii) The requirements of paragraph (b)(2)(ii) of this section are met; and
   (iv) The child restraint system has one or more of the labels described in paragraphs (b)(2)(ii)(A) through (b)(2)(ii)(C) of this section.
(3) This section does not prohibit the certificate holder from providing child restraint systems authorized by this section or, consistent with safe operating practices, determining the best appropriate passenger seat location for the child restraint system.
(d) Each sideward facing seat must comply with the applicable requirements of Sec. 25.785(c) of this chapter.
(e) No certificate holder may take off or land an airplane unless each passenger seat back is in the upright position. Each passenger shall comply with instructions given by a crewmember in compliance with this paragraph. This paragraph does not apply to seats on which cargo or persons who are unable to sit erect for a medical reason are carried in accordance with procedures in the certificate holder’s manual if the seat back does not obstruct any passenger’s access to the aisle or to any emergency exit.
(f) Each occupant of a seat equipped with a shoulder harness must fasten the shoulder harness during takeoff and landing, except that, in the case of crewmembers, the shoulder harness need not be fastened if the crewmember cannot perform his required duties with the shoulder harness fastened.
FAR 23.561 General.

(a) The airplane, although it may be damaged in emergency landing conditions, must be designed as prescribed in this section to protect each occupant under those conditions.

(b) The structure must be designed to protect each occupant during emergency landing conditions when—
(1) Proper use is made of the seats, safety belts, and shoulder harnesses provided for in the design;
(2) The occupant experiences the static inertia loads corresponding to the following ultimate load factors—
   (i) Upward, 3.0g for normal, utility, and commuter category airplanes, or 4.5g for acrobatic category airplanes;
   (ii) Forward, 9.0g;
   (iii) Sideward, 1.5g; and
(3) The items of mass within the cabin, that could injure an occupant, experience the static inertia loads corresponding to the following ultimate load factors—
   (i) Upward, 3.0g;
   (ii) Forward, 18.0g; and
   (iii) Sideward, 4.5g.

c) Each airplane with retractable landing gear must be designed to protect each occupant in a landing—
(1) With the wheels retracted;
(2) With moderate descent velocity; and
(3) Assuming, in the absence of a more rational analysis—
   (i) A downward ultimate inertia force of 3 g; and
   (ii) A coefficient of friction of 0.5 at the ground.

d) If it is not established that a turnover is unlikely during an emergency landing, the structure must be designed to protect the occupants in a complete turnover as follows:
(1) The likelihood of a turnover may be shown by an analysis assuming the following conditions—
   (i) Maximum weight;
   (ii) Most forward center of gravity position;
   (iii) Longitudinal load factor of 9.0g;
   (iv) Vertical load factor of 1.0g; and
   (v) For airplanes with tricycle landing gear, the nose wheel strut fails with the nose contacting the ground.
(2) For determining the loads to be applied to the inverted airplane after a turnover, an upward ultimate inertia load factor of 3.0g and a coefficient of friction with the ground of 0.5 must be used.

Sec. 25.562 Emergency landing dynamic conditions.

(a) The seat and restraint system in the airplane must be designed as prescribed in this section to protect each occupant during an emergency landing condition when:

1. Proper use is made of seats, safety belts, and shoulder harnesses provided for in the design; and
2. The occupant is exposed to loads resulting from the conditions prescribed in this section.

(b) Each seat type design approved for crew or passenger occupancy during takeoff and landing must successfully complete dynamic tests or be demonstrated by rational analysis based on dynamic tests of a similar type seat, in accordance with each of the following emergency landing conditions. The tests must be conducted with an occupant simulated by a 170-pound anthropomorphic test dummy, as defined by 49 CFR Part 572, Subpart E, or its equivalent, sitting in the normal upright position:

1. A change in downward vertical velocity ($\Delta v$) of not less than 35 feet per second, with the airplane's longitudinal axis canted downward 30 degrees with respect to the horizontal plane and with the wings level. Peak floor deceleration must occur in not more than 0.06 seconds after impact and must reach a minimum of 14g.
2. A change in forward longitudinal velocity ($\Delta v$) of not less than 44 feet per second, with the airplane's longitudinal axis horizontal and yawed 10 degrees either right or left, whichever would cause the greatest likelihood of the upper torso restraint system (where installed) moving off the occupant's shoulder, and with the wings level. Peak floor deceleration must occur in not more than 0.09 seconds after impact and must reach a minimum of 16g. Where floor rails or floor fittings are used to attach the seating devices to the test fixture, the rails or fittings must be misaligned with respect to the adjacent set of rails or fittings by at least 10 degrees vertically (i.e., out of Parallel) with one rolled 10 degrees.

(c) The following performance measures must not be exceeded during the dynamic tests conducted in accordance with paragraph (b) of this section:

1. Where upper torso straps are used for crewmembers, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.
2. The maximum compressive load measured between the pelvis and the lumbar column of the anthropomorphic dummy must not exceed 1,500 pounds.
3. The upper torso restraint straps (where installed) must remain on the occupant's shoulder during the impact.
4. The lap safety belt must remain on the occupant's pelvis during the impact.
Each occupant must be protected from serious head injury under the conditions prescribed in paragraph (b) of this section. Where head contact with seats or other structure can occur, protection must be provided so that the head impact does not exceed a Head Injury Criterion (HIC) of 1,000 units. The level of HIC is defined by the equation:

\[
\text{HIC} = \frac{\int_{t_1}^{t_2} (a(t))^2 dt}{\left( \frac{\pi^2}{2} \right)^2}
\]

Where:
- \(t_1\) is the initial integration time,
- \(t_2\) is the final integration time, and
- \(a(t)\) is the total acceleration vs. time curve for the head strike, and
- the integration is performed over the time interval from \(t_1\) to \(t_2\).

Where \(t_1\) is in seconds, and \(a(t)\) is in units of gravity (g).

(6) Where leg injuries may result from contact with seats or other structure, protection must be provided to prevent axially compressive loads exceeding 2,250 pounds in each femur.

(7) The seat must remain attached at all points of attachment, although the structure may have yielded.

(8) Seats must not yield under the tests specified in paragraphs (b)(1) and (b)(2) of this section to the extent they would impede rapid evacuation of the airplane occupants.

[Amdt. 25-64, 53 FR 17646, May 17, 1988]

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Sec. 135.128 Use of safety belts and child restraint systems.

(a) Except as provided in this paragraph, each person on board an aircraft operated under this part shall occupy an approved seat or berth with a separate safety belt properly secured about him or her during movement on the surface, takeoff, and landing. For seaplane and float equipped rotorcraft operations, the person pushing off the seaplane or rotorcraft from the dock and the person mooring the seaplane or rotorcraft at the dock are excepted from the preceding seating and safety belt requirements. A safety belt provided for the occupant of a seat may not be used by more than one person who has reached his or her second birthday. Notwithstanding the preceding requirements, a child may:

(1) Be held by an adult who is occupying an approved seat or berth, provided the child has not reached his or her second birthday and the child does not occupy or use any restraining device; or

(2) Notwithstanding any other requirement of this chapter, occupy an approved child restraint system furnished by the certificate holder or one of the persons described in paragraph (a)(2)(i) of this section, provided:

(i) The child is accompanied by a parent, guardian, or attendant designated by the child's parent or guardian to attend to the safety of the child during the flight;

(ii) Except as provided in paragraph (a)(2)(i)(D) of this section, the approved child restraint system bears one or more labels as follows:

(A) Seats manufactured to U.S. standards between January 1, 1981, and February 25, 1985, must bear the label: "This child restraint system conforms to all applicable Federal motor vehicle safety standards";

(B) Seats manufactured to U.S. standards on or after February 26, 1985, must bear two labels:

(1) "This child restraint system conforms to all applicable Federal motor vehicle safety standards"; and

(2) "THIS RERAINT IS CERTIFIED FOR USE IN MOTOR VEHICLES AND AIRCRAFT" in red lettering;

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(C) Seats that do not qualify under paragraphs (a)(2)(i)(A) and (a)(2)(i)(B) of this section must bear either a label showing approval of a foreign government or a label showing that the seat was manufactured under the standards of the United Nations;

(D) Notwithstanding any other provision of this section, booster-type child restraint systems (as defined in Federal Motor Vehicle Standard No 213 (49 CFR 571.213)), vest- and harness-type child restraint systems, and lap held child restraints are not approved for...
use in aircraft; and

(iii) The certificate holder complies with the following requirements:

(A) The restraint system must be properly secured to an approved forward-facing seat or berth;

(B) The child must be properly secured in the restraint system and must not exceed the specified weight limit for the restraint system; and

(C) The restraint system must bear the appropriate label(s).

(b) Except as provided in paragraph (b)(3) of this section, the following prohibitions apply to certificate holders:

(1) No certificate holder may permit a child, in an aircraft, to occupy a booster-type child restraint system, a vest-type child restraint system, a harness-type child restraint system, or a lap held child restraint system during take off, landing, or movement on the surface.

(2) Except as required in paragraph (b)(1) of this section, no certificate holder may prohibit a child, if requested by the child's parent, guardian, or designated attendant, from occupying a child restraint system furnished by the child's parent, guardian, or designated attendant provided:

(i) The child holds a ticket for an approved seat or berth or such seat or berth is otherwise made available by the certificate holder for the child's use;

(ii) The requirements of paragraph (a)(2)(i) of this section are met;

(iii) The requirements of paragraph (a)(2)(ii) of this section are met; and

(iv) The child restraint system has one or more of the labels described in paragraphs (a)(2)(i)(A) through (a)(2)(i)(C) of this section.

(3) This section does not prohibit the certificate holder from providing child restraint systems authorized by this or, consistent with safe operating practices, determining the most appropriate passenger seat location for the child restraint system.

Sec. 571.213 Standard No. 213, Child restraint systems

S1. Scope. This standard specifies requirements for child restraint systems used in motor vehicles and aircraft.

S2. Purpose. The purpose of this standard is to reduce the number of children killed or injured in motor vehicle crashes and in aircraft.

S3. Application. This standard applies to passenger cars, multipurpose passenger vehicles, trucks and buses, and to child restraint systems for use in motor vehicles and aircraft.

S4. Definitions.

- Add-on child restraint system means any portable child restraint system.
- Backless child restraint system means a child restraint, other than a belt-positioning seat, that consists of a seating platform that does not extend up to provide a cushion for the child's back or head and has a structural element designed to restrain forward motion of the child's torso in a forward impact.
- Belt-positioning seat means a child restraint system that positions a child on a vehicle seat to improve the fit of a vehicle Type II belt system on the child and that lacks any component, such as a belt system or a structural element, designed to restrain forward movement of the child's torso in a forward impact.
- Booster seat means either a backless child restraint system or a belt-positioning seat.
- Built-in child restraint system means a child restraint system that is designed to be an integral part of and permanently installed in a motor vehicle.
- Car bed means a child restraint system designed to restrain or position a child in the supine or prone position on a continuous flat surface.
- Child restraint system means any device except Type I or Type II seat belts, designed for use in a motor vehicle or aircraft to restrain, seat, or position children who weigh 50 pounds or less.
- Contactable surface means any child restraint system surface (other than that of a belt, belt buckle, or belt adjustment hardware) that may contact any part of the head or torso of the appropriate test dummy, specified in S7, when a child restraint system is tested in accordance with S6.1.
- Factory-installed built-in child restraint system means a built-in child restraint system that has been or will be permanently installed in a motor vehicle before that vehicle is certified as a completed or altered vehicle in accordance with part 567 of this chapter.
- Rear-facing child restraint system means a child restraint system, except a car bed, that positions a child to face in the direction opposite to the normal direction of travel of the motor vehicle.
Representative aircraft passenger seat means either a Federal Aviation Administration approved production aircraft passenger seat or a simulated aircraft passenger seat conforming to Figure 6.

Seat orientation reference line or SORL means the horizontal line through Point Z as illustrated in Figure 1A.

Specific vehicle shell means the actual vehicle model part into which the built-in child restraint system is or is intended to be fabricated, including the complete surroundings of the built-in system. If the built-in child restraint system is or is intended to be fabricated as part of any seat other than a front seat, these surroundings include the back of the seat in front, the interior rear side door panels and trim, the floor pan, adjacent pillars (e.g., the B and C pillars), and the ceiling. If the built-in system is or is intended to be fabricated as part of the front seat, these surroundings include the dashboard, the steering mechanism and its associated trim hardware, any levers and knobs installed on the floor or on a console, the interior front side door panels and trim, the front seat, the floor pan, the A pillars and the ceiling.

Torso means the portion of the body of a seated anthropomorphic test dummy, excluding the thighs, that lies between the top of the child restraint system seating surface and the top of the shoulders of the test dummy.

S5. Requirements. (a) Each motor vehicle with a built-in child restraint system shall meet the requirements in this section when, as specified, tested in accordance with S6.1 and this paragraph.
(b) Each child restraint system manufactured for use in motor vehicles shall meet the requirements in this section when, as specified, tested in accordance with S6.1 and this paragraph. Each add-on system shall meet the requirements at each of the restraint’s seat back angle adjustment positions and restraint belt routing positions, when the restraint is oriented in the direction recommended by the manufacturer (e.g., forward, rearward or laterally) pursuant to S5.6, and tested with the test dummy specified in S7.
(c) Each child restraint system manufactured for use in aircraft shall meet the requirements in this section and the additional requirements in S8.

S5.1 Dynamic performance.

S5.1.1 Child restraint system integrity When tested in accordance with S6.1, each child restraint system shall meet the requirements of paragraphs (a) through (c) of this section.
(a) Exhibit no complete separation of any load bearing structural element and no partial separation exposing either surfaces with a radius of less than \(\frac{1}{4}\) inch or surfaces with protrusions greater than \(\frac{3}{8}\) inch above the immediate adjacent surrounding contactable surface of any structural element of the system.
(b) (1) If adjustable to different positions, remain in the same adjustment position during the testing that it was in immediately before the testing, except as otherwise specified in paragraph (b)(2).
(2) (i) Subject to paragraph (b)(2)(ii), a rear-facing child restraint system may have a means for repositioning the seating surface of the system that allows the system's occupant to move from a reclined position to an upright position and back to a reclined position during testing.
(ii) No opening that is exposed and is larger than \(\frac{1}{4}\) inch before the testing shall become smaller during the testing as a result of the movement of the seating surface relative to the restraint system as a whole.
(c) If a front facing child restraint system, not allow the angle between the system's back support surfaces for the child and the system's seating surface to be less than 45 degrees at the completion of the test.
S5.1.2 Injury criteria. When tested in accordance with S6.1, each child restraint system that, in accordance with S5.5.2(f), is recommended for use by children whose masses are more than 10 kilograms (kg) shall—

(a) Limit the resultant acceleration at the location of the accelerometer mounted in the test dummy head as specified in part 572 such that the expression:

\[ |a| \leq 1000 \quad \text{such that} \quad \begin{cases} t_1 \leq t \leq t_2 \\ t_2 > t_1 \end{cases} \]

shall not exceed 1,000, where \( a \) is the resultant acceleration expressed as a multiple of \( g \) (the acceleration of gravity), and \( t_1 \) and \( t_2 \) are any two moments during the impacts.

(b) Limit the resultant acceleration at the location of the accelerometer mounted in the test dummy upper thorax as specified in part 572 to not more than 60 g's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S5.1.3 Occupant excursion. When tested in accordance with S6.1, each child restraint system shall meet the applicable excursion limit requirements specified in S5.1.3.1-S5.1.3.3.

S5.1.3.1 Child restraint systems other than rear-facing ones and car beds. Each child restraint system, other than a rear-facing child restraint system or a car bed, shall retain the test dummy's torso within the system

(a) In the case of an add-on child restraint system, no portion of the test dummy's head shall pass through a vertical, transverse plane that is 813 mm forward of point Z on the standard seat assembly, measured along the center SORL (as illustrated in figure 1B), and neither knee pivot point shall pass through a vertical, transverse plane that is 915 mm forward of point Z on the standard seat assembly, measured along the center SORL.

(b) In the case of a built-in child restraint system, neither knee pivot point shall, at any time during the dynamic test, pass through a vertical, transverse plane that is 305 mm forward of the initial pre-test position of the respective knee pivot point, measured along a horizontal line that passes through the knee pivot point and is parallel to the vertical plane that passes through the vehicle's longitudinal centerline.

S5.1.3.2 Rear-facing child restraint systems. In the case of each rear-facing child restraint system, all portions of the test dummy's torso shall be retained within the system and neither of the target points on either side of the dummy's head and on the transverse axis passing through the center of mass of the dummy's head and perpendicular to the head's midsagittal plane, shall pass through the transverse orthogonal planes whose intersection contains the forward-most and top-most points on the child restraint system surfaces (illustrated in Figure 1C).

S5.1.3.3 Car beds. In the case of car beds, all portions of the test dummy's head and torso shall be retained within the confines of the car bed.

S5.1.4 Back support angle. When a rear-facing child restraint system is tested in accordance with S6.1, the angle between the system's back support surface for the child and the vertical shall not exceed 70 degrees.

S5.2 Force distribution.

S5.2.1 Minimum head support surface—child restraints other than car beds.

S5.2.1.1 Except as provided in S5.2.1.2, each child restraint system other than a car bed shall provide restraint against rearward movement of the head of the child (rearward in relation to the child) by means of a continuous seat back which is an integral part of the system and
which—

(a) Has a height, measured along the system seat back surface for the child in the vertical longitudinal plane passing through the longitudinal centerline of the child restraint systems from the lowest point on the system seating surface that is contacted by the buttocks of the seated dummy, as follows:

+-----------------------------------------------+-----+
| Weight\1\ (in pounds) | Height\2\ (in inches) |
|------------------------+-----|
| Less than 20 lb.       | 18  |
| 20 lb or more, but not more than 40 lb. | 20  |
| More than 40 lb        | 22  |
+-----------------------------------------------+-----+

\1\ When a child restraint system is recommended under S5.5(f) for use by children of the above weights.
\2\ The height of the portion of the system seat back providing head restraint shall not be less than the above.

(b) Has a width of not less than 8 inches, measured in the horizontal plane at the height specified in paragraph (a) of this section. Except that a child restraint system with side supports extending at least 4 inches forward from the padded surface of the portion of the restraint system provided for support of the child's head may have a width of not less than 6 inches, measured in the horizontal plane at the height specified in paragraph (a) of this section.

(c) Limits the rearward rotation of the test dummy head so that the angle between the head and torso of the dummy specified in S7, when tested in accordance with S6.1 is not more than 45 degrees greater than the angle between the head and torso after the dummy has been placed in the system in accordance with S6.1.2.3 and before the system is tested in accordance with S6.1.

S5.2.1.2 The applicability of the requirements of S5.2.1.1 to a front-facing child restraint, and the conformance of any child restraint other than a car bed to those requirements is determined using the largest of the test dummies specified in S7.1 for use in testing that restraint; provided, that the 6-year-old dummy described in part 572 of this title is not used to determine the applicability of or compliance with S5.2.1.1. A front-facing child restraint system is not required to comply with S5.2.1.1 if the target point on either side of the dummy's head is below a horizontal plane tangent to the top of—

(a) The standard seat assembly, in the case of an add-on child restraint system, when the dummy is positioned in the system and the system is installed on the assembly in accordance with S6.1.2.

(b) The vehicle seat, in the case of a built-in child restraint system, when the system is activated and the dummy is positioned in the system in accordance with S6.1.2.

S5.2.2 Torso impact protection. Each child restraint system other than a car bed shall comply with the applicable requirements of S5.2.2.1 and S5.2.2.2.

S5.2.2.1(a) The system surface provided for the support of the child's back shall be flat or concave and have a continuous surface area of not less than 85 square inches.

(b) Each system surface provided for support of the child's torso shall be flat or concave and have a continuous surface of not less than 24 square inches for systems recommended for children weighing 20 pounds or more, or 48 square inches for systems recommended for children weighing less than 20 pounds.
(c) Each horizontal cross section of each system surface designed to restrain forward movement of the child's torso shall be flat or concave and each vertical longitudinal cross section shall be flat or convex with a radius of curvature of the underlying structure of not less than 2 inches.

S5.2.2.2 Each forward-facing child restraint system shall have no fixed or movable surface—
(a) Directly forward of the dummy and intersected by a horizontal line—
(1) Parallel to the SORL, in the case of the add-on child restraint system, or
(2) Parallel to a vertical plane through the longitudinal center line of the vehicle seat, in the case of a built-in child restraint system, and,
(b) Passing through any portion of the dummy, except for surfaces which restrain the dummy when the system is tested in accordance with S6.1.2(a)(2), so that the child restraint system shall conform to the requirements of S5.1.2 and S5.1.3.1.

S5.2.3 Head impact protection.

S5.2.3.1 Each child restraint system, other than a child harness, which is recommended under S5.5.2(f) for children whose masses are less than 10 kg, shall comply with S5.2.3.2.

S5.2.3.2 Each system surface, except for protrusions that comply with S5.2.4, which is contactable by the dummy head when the system is tested in accordance with S6.1 shall be covered with slow recovery, energy absorbing material with the following characteristics:
(a) A 25 percent compression-deflection resistance of not less than 0.5 and not more than 10 pounds per square inch when tested in accordance with S6.3.
(b) A thickness of not less than \( \frac{1}{2} \) inch for materials having a 25 percent compression-deflection resistance of not less than 1.8 and not more than 10 pounds per square inch when tested in accordance with S6.3. Materials having a 25 percent compression-deflection resistance of less than 1.8 pounds per square inch shall have a thickness of not less than \( \frac{3}{4} \) inch.

S5.2.4 Protrusion limitation. Any portion of a rigid structural component within or underlying a contactable surface, or any portion of a child restraint system surface that is subject to the requirements of S5.2.3 shall, with any padding or other flexible overlay material removed, have a height above any immediately adjacent restraint system surface of not more than \( \frac{3}{8} \) inch and no exposed edge with a radius of less than \( \frac{1}{4} \) inch.

S5.3 Installation.

S5.3.1 Each add-on child restraint system shall have no means designed for attaching the system to a vehicle seat cushion or vehicle seat back and no component (except belts) that is designed to be inserted between the vehicle seat cushion and vehicle seat back.

S5.3.2 When installed on a vehicle seat, each add-on child restraint system, other than child harnesses and belt-positioning seats, shall be capable of being restrained against forward movement solely by means of a Type I seat belt assembly (defined in Sec. 571.209) that meets Standard No. 208 (Sec. 571.208), or by means of a Type I seat belt assembly plus one additional anchorage strap that is supplied with the system and conforms to S5.4. Each belt-positioning seat shall be capable of being restrained against forward movement solely by means of a Type II seat belt assembly (defined in Sec. 571.209) that meets Standard No. 208 (Sec. 571.208).

S5.3.3 Car beds. Each car bed shall be designed to be installed on a vehicle seat so that the car bed's longitudinal axis is perpendicular to a vertical longitudinal plane through the longitudinal axis of the vehicle seat.
S5.4 Belts, belt buckles, and belt webbing.

S5.4.1 Performance requirements. The webbing of belts provided with a child restraint system and used to attach the system to the vehicle or to restrain the child within the system shall—

(a) After being subjected to abrasion as specified in S5.1(d) or S5.3(c) of FMVSS 209 (Sec. 571.209), have a breaking strength of not less than 75 percent of the strength of the unabraded webbing when tested in accordance with S5.1(b) of FMVSS 209.

(b) Meet the requirements of S4.2(e) and (f) of FMVSS No. 209 (Sec. 571.209); and

(c) If contactable by the test dummy torso when the system is tested in accordance with S6.1, have a width of not less than 1\1/2\ inches when measured in accordance with S5.4.1.1.

S5.4.1.1 Width test procedure. Condition the webbing for 24 hours in an atmosphere of any relative humidity between 48 and 67 percent, and any ambient temperature between 70 deg. and 77 deg. F. Measure belt webbing width under a tension of 5 pounds applied lengthwise.

S5.4.2 Belt buckles and belt adjustment hardware. Each belt buckle and item of belt adjustment hardware used in a child restraint system shall conform to the requirements of S4.3(a) and S4.3(b) of FMVSS No. 209 (Sec. 571.209).

S5.4.3 Belt Restraint.

S5.4.3.1 General. Each belt that is part of a child restraint system and that is designed to restrain a child using the system shall be adjustable to snugly fit any child whose height and weight are within the ranges recommended in accordance with S5.5.2(f) and who is positioned in the system in accordance with the instructions required by S5.6.

S5.4.3.2 Direct restraint. Except for a child restraint system whose mass is less than 4.4 kg, each belt that is part of a child restraint system and that is designed to restrain a child using the system and to attach the system to the vehicle, and each Type I and lap portion of a Type II vehicle belt that is used to attach the system to the vehicle shall, when tested in accordance with S6.1, impose no loads on the child that result from the mass of the system, or

(a) In the case of an add-on child restraint system, from the mass of the seat back of the standard seat assembly specified in Sec 1, or

(b) In the case of a built-in child restraint system, from the mass of any part of the vehicle into which the child restraint system is built.

S5.4.3.3 Seating systems. Except for child restraint systems subject to S5.4.3.4, each child restraint system that is designed for use by a child in a seated position and that has belts designed to restrain the child, shall, with the test dummy specified in S7 positioned in the system in accordance with S10 provide:

(a) Upper torso restraint in the form of:

(i) Belts passing over each shoulder of the child, or

(ii) A fixed or movable surface that complies with S5.2.2.1(c), and

(b) Lower torso restraint in the form of:

(i) A lap belt assembly making an angle between 45 deg. and 90 deg. with the child restraint seating surface at the lap belt attachment points, or

(ii) A fixed or movable surface that complies with S5.2.2.1(c), and

(c) In the case of each seating system recommended for children whose masses are more than 10 kg, crotch restraint in the form of:

(i) A crotch belt connectable to the lap belt or other device used to restrain the lower torso, or

(ii) A fixed or movable surface that complies with S5.2.2.1(c).

S5.4.3.4 Harnesses. Each child harness shall:

(a) Provide upper torso restraint, including belts passing over each shoulder of the child;

(b) Provide lower torso restraint by means of lap and crotch belt,
(c) Prevent a child of any height for which the restraint is recommended for use pursuant to S5.5.2(f) from standing upright on the vehicle seat when the child is placed in the device in accordance with the instructions required by S5.6.

S5.4.3.5 Buckle release. Any buckle in a child restraint system belt assembly designed to restrain a child using the system shall:

(a) When tested in accordance with S6.2.1 prior to the dynamic test of S6.1, not release when a force of less than 40 newtons (N) is applied and shall release when a force of not more than 62 N is applied;

(b) After the dynamic test of S6.1, when tested in accordance with the appropriate sections of S6.2, release when a force of not more than 71 N is applied, provided, however, that the conformance of any child restraint to this requirement is determined using the largest of the test dummies specified in S7 for use in testing that restraint when the restraint is facing forward, rearward, and/or laterally;

(c) Meet the requirements of S4.3(d)(2) of FMVSS No. 209 (Sec. 571.209), except that the minimum surface area for child restraint buckles designed for push button application shall be 0.6 square inch;

(d) Meet the requirements of S4.3(g) of FMVSS No. 209 (Sec. 571.209) when tested in accordance with S5.2(g) of FMVSS No. 209; and

(e) Not release during the testing specified in S6.1.

S5.5 Labeling.

S5.5.1 Each add-on child restraint system shall be permanently labeled with the information specified in S5.5.2 (a) through (m)

S5.5.2 The information specified in paragraphs (a) through (n) of this section shall be stated in the English language and lettered in letters and numbers that are not smaller than 10 point type and are of a contrasting background.

(a) The model name or number of the system.

(b) The manufacturer’s name. A distributor’s name may be used instead if the distributor assumes responsibility for all duties and liabilities imposed on the manufacturer with respect to the system by the National Traffic and Motor Vehicle Safety Act, as amended

(c) The statement: "Manufactured in ____," inserting the month and year of manufacture.

(d) The place of manufacture (city and State, or foreign country).

However, if the manufacturer uses the name of the distributor, the label shall state the location (city and State, or foreign country) of the principal offices of the distributor.

(e) The statement: "This child restraint system conforms to all applicable Federal motor vehicle safety standards."

(f) One of the following statements, inserting the manufacturer’s recommendations for the maximum mass and height of children who can safely occupy the system, except that booster seats shall not be recommended for children whose masses are less than 13.6 kg:

(1) This infant restraint is designed for use by children who weigh ______ pounds (__________ kg) or less and whose height is ______ pounds (__________ kg) or less and whose height is

(2) This child restraint is designed for use only by children who weigh between ______ and ______ pounds (__________ kg) or less and whose height is

(3) This child restraint is designed for use only by children who weigh between ______ and ______ pounds (insert appropriate metric values; use of word ‘mass’ is optional)
or less and who are capable of sitting upright alone; or

(3) This child restraint is designed for use only by children who weigh between __________ and __________ pounds (insert appropriate metric values; use of word "mass" is optional). 1/11/55/2 5/62/32/51/67/2 2/37/23/31/32/6 3/31/6 1/27/22/65/67/27/21/5 1/11/55/2 3/31/53/22/37/21/6

(g) The following statement, inserting the location of the manufacturer's installation instruction booklet or sheet on the restraint:

WARNING! FAILURE TO FOLLOW EACH OF THE FOLLOWING INSTRUCTIONS CAN RESULT IN YOUR CHILD STRIKING THE VEHICLE'S INTERIOR DURING A SUDDEN STOP OR CRASH.

SECURE THIS CHILD RESTRAINT WITH A VEHICLE BELT AS SPECIFIED IN THE MANUFACTURER'S INSTRUCTIONS LOCATED _______.

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(n) In the case of each child restraint system that has belts designed to restrain children using them:

SNUGLY ADJUST THE BELTS PROVIDED WITH THIS CHILD RESTRAINT AROUND YOUR CHILD.

(i)(1) For a booster seat that is recommended for use with either a vehicle's Type I or Type II seat belt assembly, one of the following statements, as appropriate:

(1) WARNING: USE ONLY THE VEHICLE'S LAP AND SHOULDER BELT SYSTEM WHEN RestRAINING THE CHILD IN THIS BOOSTER SEAT; or,

(11) WARNING: USE ONLY THE VEHICLE'S LAP BELT SYSTEM, OF THE LAP BELT PART OF A LAP/SHOULDER BELT SYSTEM WITH THE SHOULDER BELT PLACED BEHIND THE CHILD, WHEN RESTRAINING THE CHILD IN THIS SEAT.

(ii) Except as provided in paragraph (i)(2)(n) of this section, for a booster seat which is recommended for use with both a vehicle's Type I and Type II seat belt assemblies, the following statement:

WARNING! USE ONLY THE VEHICLE'S LAP BELT SYSTEM, OR THE LAP BELT PART OF A LAP/SHOULDER BELT SYSTEM WITH THE SHOULDER BELT PLACED BEHIND THE CHILD, WHEN RESTRAINING THE CHILD WITH THE insert description of the system element provided to restrain forward movement of the child's torso when used with a lap belt (e.g., shield), AND ONLY THE VEHICLE'S LAP AND SHOULDER BELT SYSTEM WHEN USING THIS BOOSTER WITHOUT THE insert above description.

(ii) A booster seat which is recommended for use with both a vehicle's Type I and Type II seat belt assemblies is not subject to §5.5.2(i)(2)(i) if, when the booster is used with the shield or similar component, the booster will cause the shoulder belt to be located in a position other than in front of the child when the booster is installed. However, such a booster shall be labeled with a warning to use the booster with the vehicle's lap and shoulder belt system when using the
booster without a shield.

(j) In the case of each child restraint system equipped with an anchorage strap, the statement:

SECURE THE TOP ANCHORAGE STRAP PROVIDED WITH THIS CHILD RESTRAINT AS SPECIFIED IN THE MANUFACTURER'S INSTRUCTIONS.

(k) At the manufacturer's option, child restraint systems manufactured before May 27, 1997 may comply with the requirements of S5.5.2(k)(4) or S5.5.2(k)(5) as appropriate, instead of the requirements of S5.5.2(k)(1)(ii) or S5.5.2(k)(2)(ii).

(1) In the case of each rear-facing child restraint system that is designed for infants only, the following statements--

(i) 'PLACE THIS INFANT RESTRAINT IN A REAR-FACING POSITION WHEN USING IT IN THE VEHICLE.'

(ii) 'WARNING: DO NOT PLACE THIS RESTRAINT IN THE FRONT SEAT OF A VEHICLE THAT HAS A PASSENGER SIDE AIR BAG. (insert a statement that describes the consequences of not following the warning.)

(2) In the case of a child restraint system that is designed to be used rearward-facing for infants and forward facing for older children, the following statements--

(i) 'PLACE THIS CHILD RESTRAINT IN A REAR-FACING POSITION WHEN USING IT WITH AN INFANT WEIGHING LESS THAN (insert a recommended weight that is not less than 20 pounds).'

(ii) 'WARNING: WHEN THIS RESTRAINT IS USED REAR-FACING, DO NOT PLACE IT IN THE FRONT SEAT OF A VEHICLE THAT HAS A PASSENGER SIDE AIR BAG. (Insert a statement that describes the consequences of not following the warning.)

(3) The statements required by paragraphs (k)(1)(ii) and (k)(2)(ii) shall be on a red, orange or yellow contrasting background, and placed on the restraint so that it is on the side of the restraint designed to be adjacent to the front passenger door of a vehicle and is visible to a person installing the rear-facing child restraint system in the front passenger seat.

(4) Except as provided in (k)(5) of this section, in the case of each child restraint system that can be used in a rear-facing position and is manufactured on or after May 27, 1997, instead of the warning specified in S5.5.2(k)(1)(ii) or S5.5.2(k)(2)(ii) of this standard, a label that conforms in content to Figure 10 and to the requirements of S5.5.2(k)(4)(i) through S5.5.2(k)(4)(iii) of this standard shall be permanently affixed to the outer surface of the cushion or padding in or adjacent to the area where a child's head would rest, so that the label is plainly visible and easily readable.

(i) The heading area shall be yellow with the word "warning" and the alert symbol in black.

(ii) The message area shall be white with black text. The message area shall be no less than 30 square cm.

(iii) The pictogram shall be black with a red circle and slash on a white background. The pictogram shall be no less than 30 mm in diameter.

(5) If a child restraint system is equipped with a device that deactivates the passenger-side air bag in a vehicle when and only when the child restraint is installed in the vehicle and provides a signal, for at least 60 seconds after deactivation, that the air bag is deactivated, the label specified in Figure 10 may include the phrase "unless air bag is off" after "on front seat with air bag."

(1) An installation diagram showing the child restraint system installed in:
A seating position equipped with a continuous-loop lap/shoulder belt; and

A seating position equipped with only a lap belt, as specified in the manufacturer's instructions.

The following statement, inserting an address and telephone number: "Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address and the restraint's model number and manufacturing date to (insert address) or call (insert telephone number). For recall information, call the U.S. Government's Auto Safety Hotline at 1-800-424-9393 (202-366-0123 in DC area)."

Child restraint systems, other than belt-positioning seats, harnesses and backless child restraint systems, may be certified as complying with the provisions of §8. Child restraints that are so certified shall be labeled with the statement "This Restraint is Certified for Use in Motor Vehicles and Aircraft." Belt-positioning seats, harnesses and backless child restraint systems shall be labeled with the statement "This Restraint is Not Certified for Use in Aircraft." The statement required by this paragraph shall be in red lettering and shall be placed after the certification statement required by §5.5.2(e).

The information specified in §5.5.2 (g) through (k) shall be located on the add-on child restraint system so that it is visible when the system is installed as specified in §5.6.1.

(a) Each built-in child restraint system other than a factory-installed built-in restraint shall be permanently labeled with the information specified in §5.5.5(a) through (j) and §5.5.5(l) shall be visible when the system is activated for use.

(b) Each factory-installed built-in child restraint shall be permanently labeled with the information specified in §5.5.5(f) through (j) and §5.5.5(l), so that the information is visible when the restraint is activated for use. The information shall also be included in the vehicle owner's manual.

The information specified in paragraphs (a) through (l) of this section that is required by §5.5.4 shall be in English and lettered in letters and numbers that are not smaller than 10-point type and are on a contrasting background:

(a) The model name or number of the system
(b) The manufacturer's name. A distributor's or dealer's name may be used instead if the distributor or dealer assumes responsibility for all duties and liabilities imposed on the manufacturer with respect to the system by the National Traffic and Motor Vehicle Safety Act, as amended
(c) The statement "Manufactured in _____,", inserting the month and year of manufacture
(d) The place of manufacture (city and State, or foreign country). However, if the manufacturer uses the name of the distributor or dealer, then it shall state the location (city and State, or foreign country) of the principal offices of the distributor or dealer
(e) The statement: "This child restraint system conforms to all applicable Federal motor vehicle safety standards."
(f) One of the following statements, inserting the manufacturer's recommendations for the maximum mass and height of children who can safely occupy the system, except that booster seats shall not be recommended for children whose masses are less than 13.6 kg:

(1) This infant restraint is designed for use by children who weigh pounds (_______ kg) or less and whose height is (insert values in English and metric units, use of word 'mass' in label is optional)<INF>x</INF>-5/<INF>sup</INF>3<INF>/sup</INF> orndash>

(2) This child restraint is designed for use only by children who
weigh between _________ and __________ pounds (insert appropriate metric values; use of word "mass" is optional) 

(1) WARNING: FAILURE TO FOLLOW THE MANUFACTURER'S INSTRUCTIONS ON THE USE OF THIS CHILD RESTRAINT SYSTEM CAN RESULT IN YOUR CHILD STRIKING THE VEHICLE'S INTERIOR DURING A SUDDEN STOP OR CRASH.

(2) In the case of each built-in child restraint system which is not intended for use in the motor vehicle in certain adjustment positions or under certain circumstances, an appropriate statement of the manufacturer's restrictions regarding those positions or circumstances, in capitalized letters.

(h) In the case of each built-in child restraint system that has belts designed to restrain children using them:

SNUGLY ADJUST THE BELTS PROVIDED WITH THIS CHILD RESTRAINT AROUND YOUR CHILD.

(1) In the case of each built-in child restraint which can be used in a rear-facing position, the following statement:

PLACE AN INFANT IN A REAR-FACING POSITION IN THIS CHILD RESTRAINT.

(3) A diagram or diagrams showing the fully activated child restraint system in infant and/or child configurations.

(k) The following statement, inserting an address and telephone number: "Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address, and the restraint's model number and manufacturing date to (insert address) or call (insert telephone number). For recall information, call the U.S. Government's Auto Safety Hotline at 1-800-424-9393 (202-366-0123 in DC area)."

(1) In the case of a built-in belt-positioning seat that uses either the vehicle's Type I or Type II belt systems or both, a statement describing the manufacturer's recommendations for the maximum height and weight of children who can safely occupy the system and how the booster should be used (e.g., with or without shield) with the different vehicle...
S5.6 Printed Instructions for Proper Use.

S5.6.1 Add-on child restraint systems. Each add-on child restraint system shall be accompanied by printed installation instructions in the English language that provide a step-by-step procedure, including diagrams, for installing the system in motor vehicles, securing the system in the vehicles, positioning a child in the system, and adjusting the system to fit the child.

S5.6.1.1 In a vehicle with rear designated seating positions, the instructions shall alert vehicle owners that, according to accident statistics, children are safer when properly restrained in the rear seating positions than in the front seating positions.

S5.6.1.2 The instructions shall specify in general terms the types of vehicles, the types of seating positions, and the types of vehicle safety belts with which the add-on child restraint system can or cannot be used.

S5.6.1.3 The instructions shall explain the primary consequences of not following the warnings required to be labeled on the child restraint system in accordance with S5.5.2 (g) through (k).

S5.6.1.4 The instructions for each car bed shall explain that the car bed should position in such a way that the child's head is near the center of the vehicle.

S5.6.1.5 The instructions shall state that add-on child restraint systems should be securely belted to the vehicle, even when they are not occupied, since in a crash an unsecured child restraint system may injure other occupants.

S5.6.1.6 Each add-on child restraint system shall have a location on the restraint for storing the manufacturer's instructions.

S5.6.1.7 The instructions shall include the following statement, inserting an address and telephone number: "Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address and the restraint's model number and manufacturing date to (insert address) or call (insert telephone number). For recall information, call the U.S. Government's Auto Safety Hotline at 1-800-424-9393 (202-366-0123 in DC area)."

S5.6.1.8 In the case of each child restraint system that can be used in a position so that it is facing the rear of the vehicle, the instructions shall provide a warning against using rear-facing restraints at seating positions equipped with air bags, and shall explain the reasons for, and consequences of not following the warning. The instructions shall also include a statement that owners of vehicles with front passenger side air bags should refer to their vehicle owner's manual for child restraint installation instructions.

S5.6.1.9 In the case of each rear-facing child restraint system that has a means for repositioning the seating surface of the system that allows the system's occupant to move from a reclined position to an upright position during testing, the instructions shall include a warning against impeding the ability of the restraint to change adjustment position.

S5.6.1.10(a) For instructions for a booster seat that is recommended for use with either a vehicle's Type I or Type II seat belt assembly, one of the following statements, as appropriate, and the reasons for the statement:

(1) WARNING! USE ONLY THE VEHICLE'S LAP AND SHOULDER BELT SYSTEM WHEN RESTRAINING THE CHILD IN THIS BOOSTER SEAT; or,

(11) WARNING! USE ONLY THE VEHICLE'S LAP BELT SYSTEM, OR THE LAP BELT PART OF A LAP/SHOULDER BELT SYSTEM WITH THE SHOULDER BELT PLACED BEHIND THE CHILD, WHEN RESTRAINING THE CHILD IN THIS SEAT.

(b)(i) Except as provided in S5.6.1.10(b)(ii), the instructions for
a booster seat that is recommended for use with both a vehicle's Type I and Type II seat belt assemblies shall include the following statement and the reasons therefor:

WARNING! USE ONLY THE VEHICLE'S LAP BELT SYSTEM, OR THE LAP BELT PART OF A LAP/SHOULDER BELT SYSTEM WITH THE SHOULDER BELT PLACED BEHIND THE CHILD, WHEN RESTRANING THE CHILD WITH THE INSERT description of the system element provided to restrain forward movement of the child's torso when used with a lap belt (e.g., shield), AND ONLY THE VEHICLE'S LAP AND SHOULDER BELT SYSTEM WHEN USING THIS BOOSTER WITHOUT THE INSERT above description.

(ii) A booster seat which is recommended for use with both a vehicle's Type I and Type II seat belt assemblies is not subject to S5.6.1.10(b)(i) if, when the booster is used with the shield or similar component, the booster will cause the shoulder belt to be located in a position other than in front of the child when the booster is installed. However, the instructions for such a booster shall include a warning to use the booster with the vehicle's lap and shoulder belt system when using the booster without a shield.

(c) The instructions for belt-positioning seats shall include the statement, "This restraint is not certified for aircraft use," and the reasons for this statement.

S5.6.2 Built-in child restraint systems. (a) Each built-in child restraint system shall be accompanied by printed instructions in English that provide a step-by-step procedure, including diagrams, for activating the restraint system, positioning a child in the system, adjusting the restraint and, if provided, the restraint harness to fit the child. The instructions for each built-in car bed shall explain that the child should be positioned in the bed in such a way that the child's head is near the center of the vehicle.

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(b) Each motor vehicle equipped with a factory-installed built-in child restraint shall have the information specified in paragraph (a) of this section included in its vehicle owner's manual.

S5.6.2.1 The instructions shall explain the primary consequences of not following the manufacturer's warnings for proper use of the child restraint system in accordance with S5.5.5 (f) through (i).

S5.6.2.2 The instructions for each built-in child restraint system other than a factory-installed restraint, shall include the following statement, inserting an address and telephone number: "Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address and the restraint's model number and manufacturing date to (insert address) or call (insert telephone number). For recall information, call the U.S. Government's Auto Safety Hotline at 1-800-424-9393 (202-366-0123 in DC area)."

S5.6.2.3. Each built-in child restraint system other than a factory-installed built-in restraint, shall have a location on the restraint for storing the instructions.

S5.6.3 Each built-in child restraint system, other than a system that has been installed in a vehicle or a factory-installed built-in system that is designed for a specific vehicle model and seating position, shall be accompanied by instructions in English that provide a step-by-step procedure for installing the system in a motor vehicle. The instructions shall specify the types of vehicles and the seating positions into which the restraint can or cannot be installed. The instructions for each car bed shall explain that the bed should be installed so that the child's head will be near the center of the vehicle.

S5.6.4 In the case of a built-in belt-positioning seat that uses either the vehicle's Type I or Type II belt systems or both, the instructions shall include a statement describing the manufacturer's
recommendations for the maximum height and weight of children who can safely occupy the system and how the booster must be used with the vehicle belt systems appropriate for the booster seat. The instructions shall explain the consequences of not following the directions. The instructions shall specify that, if the booster seat is recommended for use with only the lap-belt part of a Type II assembly, the shoulder belt portion of the assembly must be placed behind the child.

S5.7 Flammability. Each material used in a child restraint system shall conform to the requirements of S4 of FMVSS No. 302 (571.302). In the case of a built-in child restraint system, the requirements of S4 of FMVSS No. 302 shall be met in both the 'in-use' and 'stowed' positions.

S5.8 Information requirements—registration form.
(a) Each child restraint system, except a factory-installed built-in restraint system, shall have a registration form attached to any surface of the restraint that contacts the dummy when the dummy is positioned in the system in accordance with S6.1.2 of Standard 213.
(b) Each form shall:
(1) Consist of a postcard that is attached at a perforation to an informational card;
(2) Conform in size, content and format to Figures 9a and 9b of this section; and
(3) Have a thickness of at least 0.007 inches and not more than 0.0095 inches.
(c) Each postcard shall provide the model name or number and date of manufacture (month, year) of the child restraint system to which the form is attached, shall contain space for the purchaser to record his or her name and mailing address, shall be addressed to the manufacturer, and shall be postage paid. No other information shall appear on the postcard, except identifying information that distinguishes a particular child restraint system from other systems of that model name or number may be preprinted in the shaded area of the postcard, as shown in figure 9a.

S6. Test conditions and procedures.
S6.1 Dynamic systems test for child restraint systems.
The test conditions described in S6.1 apply to the dynamic systems test. The test procedure for the dynamic systems test is specified in S6.1.2. The test dummy specified in S7

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is placed in the test specimen (child restraint), clamped as described in S9 and positioned according to S10.
S6.1.1 Test conditions.
(a) Test devices.
(1) The test device for add-on restraint systems is a standard seat assembly consisting of a simulated vehicle bench seat, with three seating positions, which is described in Drawing Package SAS-100-1000 (consisting of drawings and a bill of materials) with addendum A, Seat Base Weldment, dated July 1, 1993 (incorporated by reference; see Sec. 571.5). The assembly is mounted on a dynamic test platform so that the center SORL of the seat is parallel to the direction of the test platform travel and so that movement between the base of the assembly and the platform is prevented.
(2) The test device for built-in child restraint systems is either the specific vehicle shell or the specific vehicle.
(A) The specific vehicle shell, if selected for testing, is mounted on a dynamic test platform so that the longitudinal center line of the shell is parallel to the direction of the test platform travel and so that movement between the base of the shell and the platform is prevented. Adjustable seats are in the adjustment position midway between the forwardmost and rearmost positions, and if separately adjustable in a vertical direction, are at the lowest position. If an
adjustment position does not exist midway between the forwardmost and rearmost position, the closest adjustment position to the rear of the midpoint is used. Adjustable seat backs are in the manufacturer's nominal design riding position. If such a position is not specified, the seat back is positioned so that the longitudinal center line of the child test dummy's neck is vertical, and if an instrumented test dummy is used, the accelerometer surfaces in the dummy's head and thorax, as positioned in the vehicle, are horizontal. If the vehicle seat is equipped with adjustable head restraints, each is adjusted to its highest adjustment position.

(B) The platform is instrumented with an accelerometer and data processing system having a frequency response of 60 Hz channel class as specified in Society of Automotive Engineers Recommended Practice J211 JUN80 "Instrumentation for Impact Tests." The accelerometer sensitive axis is parallel to the direction of test platform travel.

(1) Specific vehicle. For built-in child restraint systems, an alternate test device is the specific vehicle into which the built-in system is fabricated. The following test conditions apply to this alternate test device.

(A) The vehicle is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage area, plus the appropriate child test dummy and, at the vehicle manufacturer's option, an anthropomorphic test dummy which conforms to the requirements of subpart B or subpart E of part 572 of this title for a 50th percentile adult male dummy placed in the front outboard seating position. If the built-in child restraint system is installed at one of the seating positions otherwise requiring the placement of a part 572 test dummy, then in the frontal barrier crash specified in (C), the appropriate child test dummy shall be substituted for the part 572 adult dummy, but only at that seating position. The fuel tank is filled to a level from 90 to 95 percent of capacity.

(B) Adjustable seats are in the adjustment position midway between the forward-most and rearmost positions, and if separately adjustable in a vehicle direction, are at the lowest position. If an adjustment position does not exist midway between the forward-most and rearmost positions, the closest adjustment position to the rear of the midpoint is used.

(C) Adjustable seat backs are in the manufacturer's nominal design riding position. If a nominal position is not specified, the seat back is positioned so that the longitudinal center line of the child test dummy's neck is vertical, and if an anthropomorphic test dummy is used, the accelerometer surfaces in the test dummy's head and thorax, as positioned in the vehicle, are horizontal. If the vehicle is equipped with adjustable head restraints, each is adjusted to its highest adjustment position.

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(D) Movable vehicle windows and vents are, at the manufacturer's option, placed in the fully closed position.

(E) Convertibles and open-body type vehicles have the top, if any, in place in the closed passenger compartment configuration.

(F) Doors are fully closed and latched but not locked.

(G) All instrumentation and data reduction is in conformance with SAE J211 JUN80.

(b) The tests are frontal barrier impact simulations of the test platform or frontal barrier crashes of the specific vehicles as specified in S5.1 of Sec. 571.208 and for:

(1) Test Configuration I, are at a velocity change of 48 km/h with the acceleration of the test platform entirely within the curve shown in Figure 2, or for the specific vehicle test with the deceleration produced in a 48 km/h frontal barrier crash.

(2) Test Configuration II, are set at a velocity change of 32 km/h with the acceleration of the test platform entirely within the curve.
shown in Figure 3, or for the specific vehicle test, with the deceleration produced in a 32 km/h frontal barrier crash.

(c) Attached to the seat belt anchorage points provided on the standard seat assembly (illustrated in Figures 1A and 1B) are Type I seat belt assemblies in the case of add-on child restraint systems other than belt-positioning seats, or Type II seat belt assemblies in the case of belt-positioning seats. These seat belt assemblies meet the requirements of Standard No. 209 (Sec. 571.209) and have webbing with a width of not more than 50 mm, and are attached to the anchorage points without the use of retractor or reels of any kind.

(d) Performance tests unde
Appendix C

Sample Questionnaire
Questionnaire to parents Who Travel on Commercial Aircraft with Children/Infants
A survey for Parents of Children 2 years old and younger.

Please circle the appropriate answer.

1. How many children do you have? 1 2 3 4

2. What are the ages of your children? 0-10 months 11-23 months 24 months and older
   0-10 months 11-23 months 24 months and older
   0-10 months 11-23 months 24 months and older

   Additional space for question #2

3. Have you ever traveled by commercial aircraft with your children? Yes No
   If you answered yes to question #3, continue with survey question #4.
   If you answered no to question #3, go to survey question #7.

4. When traveling on commercial airplane, do you use a certified child/infant safety seat? Yes No

5. Did the airline personnel suggest that you use a safety seat or child restraint system for your child? Yes No
   Additional space for question #5

6. When traveling on a commercial airplane, do you purchase a ticket (for a seat) for your child? Yes No

7. If you were required to purchase a ticket for your child to fly on a commercial airplane, how much would you be willing to pay?
   A) I am willing to pay the same price for my seat and my child’s seat.
   B) I am willing to pay 75% of the price of my seat for my child’s seat.
   C) I am willing to pay 50% of the price of my seat for my child’s seat.
   D) I am not willing to pay for my child to have his/her/their own seat(s).

8. Have you ever considered the overall safety of your child/infant while traveling by commercial airplane? Yes No
   Additional space for question #8

9. If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for your child/infant to be seated in such a seat (the child/infant seat located in proximity to your own)? Yes No
   Additional space for question #9

10. Do you have a Car Seat for your child/children/infant? Yes No

11. If you do presently own a Car Seat, is it Approved for use in Aircraft? Yes No I don’t know

Thank you for your time!
Appendix D

Survey Findings
1. How many children do you have?

<table>
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<td>38.3</td>
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<tr>
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<td>.9</td>
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**child1**

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**child2**

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**child3**

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</thead>
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<td>24 month and older</td>
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**child4**

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3. Have you ever traveled by commercial aircraft with your children?

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<td>115</td>
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</tbody>
</table>

4. When traveling on commercial airplane, do you use a certified child/infant safety seat?

<table>
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5. Did the airline personnel suggest that you use a safety seat or child restraint system for your child?

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6. When traveling on a commercial airplane, do you purchase a ticket (for a seat) for your child?

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7. If you were required to purchase a ticket for your child to fly on a commercial airplane, how much would you be willing to pay?

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<tr>
<td>willing to pay 75% of an adult ticket</td>
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<td>2.6</td>
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<tr>
<td>willing to pay 50% of an adult ticket</td>
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<td>54.8</td>
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8. Have you ever considered the overall safety of your child/infant while traveling by commercial airplane?

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</table>

9. If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for your child/infant to be seated in such a seat (the child/infant seat located in approximate to your own)?

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10. Do you have a car seat for your child/infant?

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11. If you do presently own a car seat, is it approved for use in aircraft?

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Appendix F

Comments from Participants
Comments

Comment by survey #4: The comment was to question #9, If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for you child/infant to be seated in such a seat (the child/infant seat located approximate to your own)? the answer was YES, and the comment was: It also has to meet all standards.

Comment by survey #9: The comment was to question #4, did the airline personnel suggest that you use a safety seat or child restraint system for your child? The answer was NO, and the comment was: Didn't know they were available.

Comment by Survey #12: The comment was to Question #9, If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for you child/infant to be seated in such a seat (the child/infant seat located approximate to your own)? the answer was NO, and the comment was: Unless mandatory.

Comment by Survey #14: The comment was to Question #9, If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for you child/infant to be seated in such a seat (the child/infant seat located approximate to your own)? the answer was YES, and the comment was: If the price was less than the cost of a regular ticket by at least 50%.

Comment by Survey #17: The comment was to question #9, If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for you child/infant to be seated in such a seat (the child/infant seat located approximate to your own)? the answer was YES, and the comment was: Additional purchase is well worth the trouble of carrying own seat.

Comment by Survey #19: The comment was to question #9, If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for you child/infant to be seated in such a seat (the child/infant seat located approximate to your own)? the answer was NO, and the comment was: I like to use my own car seat if I have to purchase a ticket for my infant.

Comment by Survey #22: The comment was to question #9, If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for you child/infant to be seated in such a seat (the child/infant seat located approximate to your own)? the answer was YES, and the comment was: As long as it wasn't the same price as mine.

Comment by Survey #25: The comment was to question #8, have you ever considered the overall safety of your child/infant while traveling by commercial airplane? the answer was YES, and the comment was: Always.
Comment by Survey #30: The comment was to question #8, have you ever considered the overall safety of your child/infant while traveling by commercial airplane? the answer was YES, and the comment was: All the time.

Comment by Survey #31: The comment was to question #9, If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for you child/infant to be seated in such a seat (the child/infant seat located approximate to your own)? the answer was YES, and the comment was: 50% or less.

Comment by Survey #33: The comment was to question #9, If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for you child/infant to be seated in such a seat (the child/infant seat located approximate to your own)? the answer was YES, and the comment was: I think it's a great idea, wow.

Comment by Survey #37: The comment was to question #9, If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for you child/infant to be seated in such a seat (the child/infant seat located approximate to your own)? the answer was YES, and the comment was: Only if the seat is next to my seat, and only if it is due to more safety for him.

Comment by Survey #39: The comment was to question #8, have you ever considered the overall safety of your child/infant while traveling by commercial airplane? the answer was YES, and the comment was: but I am not willing to pay for a seat if it cost full price.

Comment by Survey #39: The comment was to question #9, If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for you child/infant to be seated in such a seat (the child/infant seat located approximate to your own)? the answer was MAYBE, and the comment was: maybe but if they were able to sit on my lap safely I wouldn't.

Comment by Survey #42: The comment was to question #9, If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for you child/infant to be seated in such a seat (the child/infant seat located approximate to your own)? the answer was YES, and the comment was: Providing it is an additional set next to mine and purchase price less than an adult ticket.

Comment by Survey #68: The comment was to question #9, If there were a seat designed for children/infants on commercial airplanes, would you purchase a ticket for you child/infant to be seated in such a seat (the child/infant seat located approximate to your own)? the answer was YES, and the comment was: Price should be less than mine.