2001 Fire and Cabin Safety Research Conference
October 2001
Evacuation Studies Session

An Update on Biodynamics Research Activities at the FAA Civil Aerospace Institute

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FAA Civil Aerospace Institute (CAMI)
Biodynamics Research Lab
This presentation describes some of the key recent research and impact testing projects conducted at CAMI’s Biodynamics Research Laboratory.

This is an update of CAMI activities since the previous International Fire and Cabin Safety Research Research Conference in 1998.

All of the presented programs are in support of FAA’s certification, policy, and research organizations responsible for the establishment and development of regulations and policies associated with aircraft crashworthiness.
Presentation ....

- Child Restraints for Transport Passenger Seats
- Side Facing Seats - Occupant Restraint Methods
- Vertical Impact Energy Absorbing Seat Developments
- Modifications to the Hybrid III ATD for FAA Seat Certification Tests
- Sport Parachutists - Restraint Systems
“Let me be clear, we are committed to two things: mandating the use of child restraint systems in aircraft and assuring that children are accorded the same level of safety as are adults.”
Child Restraints

Research Activities:

Development of test methodology and pass/fail criteria for new SAE Aerospace Standard.

Conducted rigid seat tests to establish lap belt, seat cushion, and test fixture parameters.

Methods based on criteria used in automobile child restraint regulations (FMVSS-213)
Child Restraints

Current Performance Criteria per FMVSS-213

FMVSS HEAD EXCURSION LIMIT
KNEE EXCURSION LIMIT

CUSHION REF. POINT (CRP)
LAP BELT ANCHOR

FMVSS-213 BELT ANCHORS

32.0 INCHES

4.0 INCHES
Child Restraints

Knee Forward Excursion Limit = 915 mm (36.0)

Head Forward Excursion Limit = 813 mm (32.0)

Seat Pivot Axis

Lap Belt Anchor Axis

Cushion Reference Point (CRP)

140 (5.5) 64 (2.5)

152 (6.0)

269 (10.6)

Dimensions shown in mm (inches).

(SAE AS-5276-1)
Adopted November 2000

FMVSS-213 Seat Fixture
Child Restraints

16g 44 f/s dynamic test with AS 5276 type cushions and lap belt anchor configuration
Child Restraints

(SAE AS-5276-1)
Adopted November 2000

TSO C-100b Notice of Proposal - Request for Comments
Federal Register Announcement - August 7, 2001
Child Restraints

Computer Modeling of Child Restraint in Airplane Seat

“Development of a Validated Aircraft Child restraint Model”
SAE 2000-0102110, Pipino, Mugnal, DeWeese
SAE Advances in Aviation Safety Conf., April 2000
Child Restraints

New Concepts  (Golden Talon Consulting)
Child Restraints

Continued research addressing the hazards for lap-held infants and "belly-belt" type restraints
Side Facing Seats
Occupant Restraints

Inflatable Tube Torso Restraint System (ITTR)
Developed by Simula Safety Systems

“Simula Lines of Inflatable Restraints Technologies”
A. Grierson, D. Dutton, USAARL Report 2000-21,
US Army Aeromedical Research Laboratory
August, 2000
Side Facing Seats
Occupant Restraints

16g, 44 f/s Impact, Side facing Hybrid III ATD, Normal Restraint
Neck Loads Instrumented, CAMI Rigid Seat Fixture.
Side Facing Seats
Occupant Restraints

16g, 44 f/s Impact, Side facing Hybrid III ATD, Inflatable Restraint Neck Loads Instrumented, CAMI Rigid Seat Fixture.
Side Facing Seats
Occupant Restraints

CAMI SLED TEST
A00022

Time (msec)

Upper Neck Mx (in-lbs)

SIMULA ITTR SIDE
FACING RESTRAINT SYSTEM

Normal webbing type restraint

Inflatable Restraint
Side Facing Seats
Occupant Restraints

Goodrich Inflatable Restraint System Tested at CAMI
Vertical Impact Energy Absorbing Seat Developments

“Design and Testing of Buckling Monocoque Seating Structures for Aircraft Seats”, Nicholson, Turnour, Chapman,

SAE Paper 1999-01-1599, April 1999
Vertical Impact Energy Absorbing Seat Developments
Vertical Impact Energy Absorbing Seat Developments

32 Gpk, 32 f/s, Combined Vertical Impact Orientation

CAMI Sled Test
A99019

Load Limited During Seat Pan Crushing
Spinal Injury Limit = 1500 Pounds
Hybrid III ATD Modification for FAA Certification Tests

“A Lumbar Spine Modification to the Hybrid III ATD for Aircraft Seat Tests”,

Gowdy, DeWeese, Beebe, et.al.,
SAE Paper 1999-01-1699, April 1999
The “FAA Hybrid III“

Hybrid II upper leg structural assembly

Hybrid II Chest Jacket

Thorax to lumbar adapter

Hybrid II abdominal insert

Hybrid II lumbar spine

Denton Model 1891 load cell and block
Comparison of Lumbar Fz Hybrid II and Hybrid III ATDs
Combined Horizontal Vertical Orientation

- Standard Hybrid II (A96042 - 043)
- Standard Hybrid III (A96039-040)
Comparison of Lumbar Fz: Hybrid II and FAA Hybrid III Combined Horizontal Vertical Orientation

![Graph showing comparison of Lumbar Fz: Hybrid II and FAA Hybrid III Combined Horizontal Vertical Orientation](image_url)

- Standard Hybrid II (A96042 - 043)
- FAA Hybrid III (A98032 - 033)
Evaluation of Improved Restraint Systems for Sport Parachutists

Gowdy, DeWeese
FAA Office of Aviation Medicine Report
DOT/FAA/AM-98/11
Sport Parachutists - Improved Cabin Restraint Systems
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(Utility Aircraft Corporation and Pacific Aerospace Corp.)

10g, 32 f/s impact test