Trends in Passenger Protection on School Buses

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2015 TZD Conference
Protection of Children in School Buses

HOW DO WE PROTECT OUR TRAVELING STUDENT PASSENGERS?
Protection of Young Children in School Buses

INFANTS

TODDLERS

PRE-SCHOOLERS
Protection of Young Children in School Buses

Where:

- Head Start
- Child Care
- Public school pre-school programs
- Public school young mothers
- Church school buses
Add-On Car Seats

Designed for Passenger Cars

- Rear Facing
- Convertible
- Forward Facing
- Combination
- Medical Seat
Protection of Young Children in School Buses

Add-On Passenger Car Seats

• Designed for passenger cars
• Difficult to install
• Space limitations
• Attachment Options:
  – LATCH / Tether Anchors
  – Lap belts
Protection of Young Children in School Buses

Add-On CSRS Just for Buses:
Attach Using a “Cam Wrap”

Safety Vests
Protection of Young Children in School Buses

Attach Using a “Cam Wrap”

- Safety Vests
- Safety Harnesses
- Modified Vest Systems

Q’Vest by Q’Straint
Protection of Young Children in School Buses

School Bus Specific Child Restraint Systems – Attach using an integrated “Cam Wrap”

School-Bus-Only CSRS

Extra Support
Protection of Young Children in School Buses

**Built-in CSRS**
- Five-point harnesses
- Forward-facing only
- No installation needed!
- Most fold away for use by others
- Best option for buses used for multiple routes
Found on a Child Care School Bus

Your CPST expertise is needed!
COMPARTMENTALIZATION: STANDARD PROTECTION FOR TRAVELING STUDENTS!
Protection of Young Children in School Buses

COMPARTMENTALIZATION: NOT FOR YOUNG CHILDREN!
Current protection
Compartmentalization - 1977

Current protection
Compartmentalization - 1977

Passive protection for **UNBELTED** passengers

Seat backs absorb passenger crash energy

Passengers remain in compartment between seats
Compartmentalization
Forward and in-position
Compartmentalization
Forward and in-position
Chalk transfer from unbelted dummies during crash test

Image transfer from passenger
School Bus Rollover Test
Ohio School Bus Rollover

Actual Rollover Crash Footage
Compartimentalization is **NOT** enough

- Designed for low-energy, frontal crashes
- Kids must be in the “compartment”
- Kids must be properly seated, forward facing
Bus Crash Demonstration | August 8, 2013

- 100 guests
- 1998 Type C school bus
- 25 mph frontal crash

Objectives:
1. Compare belted and unbelted passengers.
2. Study motions of out of position passengers.
3. Provide school transportation leaders with insights to seat belt issue.
7 On-Board Digital Imagers, 3 On-Board Real Time Video Camera’s, 6 Outside Cameras

- Preschooler – 5pt
- Unbelted
- Lap-Shoulder Belt
- High Speed Camera
- Real Time Camera
- Factory Seat
- SafeGuard Seat
Row 5-6

Out of position students

Teenager facing aisle

6 year old facing rearward

Preschooler – 5pt
Unbelted
Row 5-6

Out of position students

Preschooler – 5pt

Unbelted
Row 10

Preschooler – 5pt
Unbelted
Lap-Shoulder Belt
2001 Type D front engine
78 Passenger
30 mph frontal crash

Objectives:
1. Test at standard 30 mph crash speed.
2. Use high back seats.
3. Compare belted and unbelted passengers.
4. Study additional out of position passenger motions.
On-Board
7 High Speed Video
4 Real Time Video

Off-Board
5 High Speed Video
5 Real Time Video

- Preschooler – 5pt
- Unbelted
- Lap-Shoulder Belt
- High Speed Camera
- Real Time Camera
- Factory Seat
- SafeGuard Seat
Out of position

Teenager facing aisle

6 year old facing rearward

Rows 4-5

Preschooler – 5pt

Unbelted

Lap-Shoulder Belt
Out of position

Preschooler – 5pt
Unbelted
Lap-Shoulder Belt
Out of position

Rows 4-5

- Preschooler – 5pt
- Unbelted
- Lap-Shoulder Belt
6 year old

Leaning forward
Reaching down

Rows 6
Out of position

Unbelted
Lap-Shoulder Belt
Preschooler – 5pt
Rows 6
Out of position

6 year old
Leaning forward
Reaching down
Rows 6
Out of position

6 year old
Leaning forward
Reaching down

Preschooler – 5pt
Unbelted
Lap-Shoulder Belt
Rows 7-8

Out of position

**Row 7:**
Teenager
Half on/half off seat
10 year old unbelted

**Row 8:**
Adult
Standing and leaning over seat
Rows 7-8

Out of position

Row 7:
Teenager
Half on/half off seat
10 year old unbelted

Row 8:
Adult
Standing and leaning over seat
Rows 7-8

Out of position

Row 7:
Teenager
Half on/half off seat
10 year old unbelted

Row 8:
Adult
Standing and leaning over seat

Legend:
- Preschooler – 5pt
- Unbelted
- Lap-Shoulder Belt
Rows 9-10

Out of position

Row 9: Unbelted adults
Row 10: Unbelted adult
Back against wall
Feet sideways

Preschooler – 5pt
Unbelted
Lap-Shoulder Belt
Rows 9-10

Out of position

Row 9: Unbelted adults
Row 10: Unbelted adult
Back against wall
Feet sideways
Rows 9-10

Out of position

Row 9: Unbelted adults

Row 10: Unbelted adult
Back against wall
Feet sideways
Rows 11-12

Row 11:
Belted
Adult + 6 year old

Row 12:
Unbelted
Adult + 6 year old
Rows 11-12

Row 11:  
Belted  
Adult + 6 year old

Row 12:  
Unbelted  
Adult + 6 year old

- Preschooler – 5pt
- Unbelted
- Lap-Shoulder Belt
Rows 11-12

Row 11:
Belted
Adult + 6 year old

Row 12:
Unbelted
Adult + 6 year old

- Preschooler – 5pt
- Unbelted
- Lap-Shoulder Belt
Bus Crash Demonstration | February 27, 2014

Objectives:
1. Study motions of out of position passengers with backpack.
2. Study compartmentalization protection of passengers with backpacks.
3. Study unsecured objects

- 1999 Thomas Type C – SWB Bus
- 22-passenger + 2 wheelchair
- 30 mph Full Frontal
Bus Crash Demonstration | Type C Bus

- Factory FMVSS 222 seats
- Lap belts removed
- One side of seats removed for cameras & lighting
- No driver occupant

Unbelted
Unsecured Objects
High Speed Video
Real Time Video

2
3
2
1
1
Row 3
Out of position

6 year old
Wearing backpack

- Unbelted
- Lap-Shoulder Belt
Row 3
Out of position

6 year old
Wearing backpack

Unbelted
Lap-Shoulder Belt
Row 5

Out of position

6 year old

Wearing backpack

Unbelted

Lap-Shoulder Belt
Row 5

Out of position

6 year old

Wearing backpack

6 |
5 |
4 |
3 |
2 |
1 |
Row 4

Out of position

Cooler and backpack

Unrestrained
Row 4

Out of position

Cooler and backpack

Unrestrained

- Unbelted
- Lap-Shoulder Belt
Objectives:
1. Study vehicle crash declarations which occur in side impact crash
2. Study motions of unrestrained and restrained passengers in side impact.
3. Study vehicle structural changes occurring in passenger area during crash
Side Impact Crash Demonstration

Type C Bus

Target Bus:
- Type C bus
- 9 passengers – 5 belted, 4 unbelted
- No driver occupant

Bullet Vehicle:
- Volvo Class 8 Conventional Tractor, weighted to 32,850 lbs.
- 40 mph impact speed
- No driver occupant

- Grey seats
  Factory installed seats standard unbelted
- Yellow seats
  Lap-Shoulder seat belts
What have we learned?
Compartmentalization is incomplete

Injury protection is limited by:
Compartmentalization Limitations

1. Type of crash
2. Interior Surroundings
3. Proper Seating Position
<table>
<thead>
<tr>
<th>Misconception</th>
<th>The Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compartmentalization is enough</td>
<td>Compartmentalization is NOT enough</td>
</tr>
<tr>
<td>Seat belts reduce capacity</td>
<td>Seat belts DO NOT reduce capacity</td>
</tr>
<tr>
<td>Seat belts will be used as weapons</td>
<td>Seat belts are NOT used as weapons</td>
</tr>
<tr>
<td>Seat belts are too expensive</td>
<td>Purchase depends on PRIORITIES</td>
</tr>
<tr>
<td>NHTSA hasn’t approved seat belts</td>
<td>NHTSA SET STANDARD for belts on buses</td>
</tr>
<tr>
<td>Seat belts slow evacuation</td>
<td>Seat belts AID evacuation</td>
</tr>
<tr>
<td>Students won’t wear them</td>
<td>Students will wear them WITH STRONG USAGE POLICY</td>
</tr>
</tbody>
</table>
Compartimentalization Protection Requires:

1. Students sit properly facing forward in compartment.
2. Backpacks must be removed and placed on the floor.
If this were YOUR child in a crash

Compartmentalization

Lap-Shoulder Belts

Which protection would YOU choose?
The Limits of Compartmentalization

MORE INFO

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