Transport Canada

Child Occupant Protection Research 
& 
Considerations for Future Regulations

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3rd Informal Child Restraint System Meeting May 13, 2008
Areas of Study

FRONTAL PROTECTION IN-VEHICLE CRASH TESTS & SLED

1. Rear facing infant seats:
   • Attachment method
   • Influence of front seat contact
   • Influence of carry handle position

2. Forward facing CRS for small to large child:
   • Attachment method:
     – top tether
     – belt + tether
     – Belt + tether + LATCH
   • LATCH dynamic load measurements
Areas of Study

FRONTAL PROTECTION IN-VEHICLE CRASH TESTS & SLED

3. Booster seats:
   • Attachment method:
   • Vehicle – booster seat interface
Areas of Study

SIDE PROTECTION IN-VEHICLE CRASH TESTS & SLED

1. Rear facing infant seats:
   • Attachment method
   • Interaction with intruding door of car-to-car
   • Interaction with other passengers

2. Forward facing CRS for small to large child:
   • Attachment method
   • Interaction with intruding door of car-to-car
   • Interaction with other passengers
Areas of Study

SIDE PROTECTION IN-VEHICLE CRASH TESTS & SLED

3. Booster seats:
   • Attachment method
   • Interaction with intruding door of car-to-car
   • Interaction with other passengers
CRS for Big Kids

Background
• Harmonize child restraint regulations
• Increase weight limit to 30 kg

What do we tell parents?
• Determine optimal attachments

Do we need to change the requirements?
• Evaluate existing regulatory requirements.
Test Matrix

- Full Frontal Rigid Barrier tests 40, 48, 56 km/h
- Sub-compact and cross-over vehicles
- Hybrid III 6-year-old & 10-year-old
- CRS labelled to 22 – 36 kg
- Top tether used for all seats
Parameters to Consider

Vehicle

- Lower anchorage strength;
- Upper tether anchorage location;
- Seat back strength and configuration;
- Seat cushion stiffness, geometry and friction;
- Seat belt geometry and webbing stiffness.
Parameters to Consider

Child Seat

• Lower anchorage belt geometry
• Tether attachment location
• Seat strength
• Lower anchorage belt stiffness
Dynamic LATCH Load Measurements
6 yr old + child seat = 32.5 kg
Measured load 4452 N (sat) Calculated load 7190 N
12 month + infant seat = 15.3 kg
Measured load 3445 N  Calculated load 3286 N
Excursion Calculations Relative to LATCH

- BELT
- BELT & LATCH

<table>
<thead>
<tr>
<th>Speed (km/h)</th>
<th>BELT</th>
<th>BELT &amp; LATCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td></td>
<td></td>
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<tr>
<td>56</td>
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<tr>
<td>56</td>
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</table>
### LATCH vs BELT + LATCH

**Dummy**: Hybrid III 6 Year Old  
**Vehicle Velocity**: 56 [km/h]  
**Vehicle Type**: Nissan Sentra  
**Vehicle mass**: 1282 [kg]

<table>
<thead>
<tr>
<th>Restraints Systems</th>
<th>14 Britax Regen (Harness+Latch+Tether)</th>
<th>15 Britax Regen (Harness+Latch+Tether)</th>
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<tbody>
<tr>
<td>Max Acceleration</td>
<td>72.3 [g] @ 0.0701 [s]</td>
<td>72.3 [g] @ 0.0701 [s]</td>
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<tr>
<td>Max Neck Force 14</td>
<td>38 766.6 [N] @ 0.0917 [s]</td>
<td>38 766.6 [N] @ 0.0917 [s]</td>
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<td>90.75 [N] @ 0.0701 [s]</td>
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<tr>
<td>MaxX-Peivis 16</td>
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</table>

### Delta V @ 52 ms

34 km/h

07-210
Considerations for Future Regulations

1. Worst case for harness
   CRS is rigidly fixed to bench
2. Worst case for excursion
   Belt + LATCH
3. Sled pulse
Infant Seats ....
Test Matrix

- Full Frontal Rigid Barrier tests 48, 56 km/h;
- Offset deformable barrier test 40km/h;
- Side impact SUV to car crashes;
- 12 month-old;
- Infant seats labelled to 22 lbs
Delta V Calculated from Ax at C.G of Vehicle

![Graph showing velocity over time](image)

- Velocity [m/s]
- Time [s]

Legend:
- Green
- Black
- Blue

The graph illustrates the change in velocity over time for different conditions, showing how the velocity decreases as time progresses.
FMVSS 213 CORRIDORS AND CORRESPONDING V

Delta V
58.8 km/h
47.7 km/h
34.9 km/h

Acceleration [G]

Time [s]
Considerations for Future Regulations

- Energy
- Dynamic orientation of the seat on seat cushion
- Infant seat must remain horizontal/level to ground
School- aged Child

- Belt migration with seatbelt only
- Shoulder roll-out on booster seats
- High neck loads associated with proximity of the torso belt to the neck;
- Chest response is unreliable due to belt position with respect to deflection instrumentation.
On Seat FFRB Test at 56km/h
Booster Seat FFRB Test at 40km/h
ISO- Booster Seat FFRB at 48 km/h
Conventional Booster Seat FFRB at 48 km/h
Considerations for Future Regulations

1. Realistic representation of child position
   slouching
2. Worst case for excursion
   adjustable seatbelt anchorage locations
3. Sled pulse
Q3s Evaluation

<table>
<thead>
<tr>
<th></th>
<th>1m</th>
<th>Struck Side</th>
<th>School Bus</th>
<th>Biofidelity</th>
<th>Non Struck side</th>
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<tr>
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<td>2007-08</td>
<td>Sled</td>
<td>Pendulum</td>
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N = 92
Car-to-car Strike – CRS
Car-to-car Strike – CRS
SUV-to-car Strike – Infant seat
Considerations for Future Regulations

1. Realistic representation of intrusion, based on car-to-car side impact crash
2. Worst case for excursion
   Include far-side occupant
3. Sled pulse