Evaluating Child Safety Innovations:
Have we got the right tools and the right test methodologies?

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Objectives

Program

1. Monitor existing regulations and provide the necessary scientific evidence for the development of new or amended regulations;

2. Provide scientific evidence to advance crash test dummy technology.
Objectives of the Study

To evaluate whether the capabilities of current child crash test dummy instrumentation and the associated metrics are adequate for the evaluation of booster seat performance.
CMVSS 213.2 Compliance

DIFFERENCES
• No retractor
• Anchor at the rear
• Belt is locked and pre-loaded
• Cushion is soft & sticky
• Seat back is unyielding

CRITERIA
• Excursion
• Chest acceleration
• Head acceleration (inertial only)
Conventional Booster Seats

• Moulded elevated base
• Arm rests serve as belt guides
• Move with the occupant
New products

- Foldable
- Inflatable
- Latch-able
CMVSS 213.2 Compliance - Foldable
Dummy Preparation HIII

Iliac load cells
Dummy Preparation Q6

APTS
## Test Matrix

<table>
<thead>
<tr>
<th></th>
<th>HIII 6</th>
<th>Q6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FRONTAL BARRIER COMPARISONS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foldable</td>
<td>X</td>
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</tr>
<tr>
<td>Inflatable</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Standard/ conventional</td>
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<td>X</td>
</tr>
<tr>
<td>ISOFIX</td>
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<tr>
<td>No booster vs foldable</td>
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<tr>
<td><strong>FRONTAL OFFSET CAR-to-CAR OBSERVATIONS</strong></td>
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<tr>
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<td>X</td>
</tr>
<tr>
<td>Inflatable</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Q6 vs HIII Foldable

Frontal Rigid Barrier 48 km/h
Q6 Standard & H3 Foldable

Frontal Rigid Barrier 48 km/h
Q6 vs. HIII Standard

Frontal Rigid Barrier 55 km/h
Q6 vs. HIII Inflatable

Frontal Rigid Barrier 55 km/h
H3 & Q6 Inflatable

Frontal Rigid Barrier 55 km/h
Q6 vs. HIII Isofix

Frontal Rigid Barrier 55 km/h
Frontal Rigid Barrier 56 km/h

(60th GRSP, 13-16 December 2016, agenda item 14)
Frontal Rigid Barrier Compliance 56 km/h

Upper pelvis excursion 305 mm

Upper pelvis excursion 138 mm
Injury Metrics

• No single instrumentation based metric that appears helpful in discriminating between good and poor retention;

• Chest deflection misleading;
  • Lowest deflection associated with slippage into the neck or under the belt
Frontal Rigid Barrier Compliance 56 km/h

Abdominal pressure sensors [bar]

<table>
<thead>
<tr>
<th>Test Code</th>
<th>Speed</th>
<th>Buckle Location</th>
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</thead>
<tbody>
<tr>
<td>TC15-206</td>
<td>48 km/h</td>
<td>Left</td>
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<tr>
<td>TC16-128</td>
<td>48 km/h</td>
<td>Right</td>
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<tr>
<td>TC 14-175</td>
<td>48 km/h</td>
<td>Right</td>
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<tr>
<td>TC17-110</td>
<td>56 km/h</td>
<td>Right</td>
</tr>
</tbody>
</table>
Frontal Rigid Barrier Compliance 56 km/h

Informal document GRSP-60-25, (60th GRSP, 13-16 December 2016, agenda item 14)
HIII Inflatable

Moving car-to-moving car frontal offset 56 km/h
Q6 on inflatable & H3 Foldable

Moving car-to-moving car frontal offset
56 km/h
H3 Foldable

Moving car-to-moving car frontal offset
56 km/h
H3 Foldable

Moving car-to-moving car frontal offset

48 km/h

Informal document GRSP-60-25,
(60th GRSP, 13-16 December 2016, agenda item 14)
Conclusions

• Movement of the HIII and the Q6 and the interactions with restraints are notably different
• Dummy measures/ traditional injury metrics were not predictive
• Variables worthy of further consideration:
  • frontal excursion
  • Pressure sensors
Conclusion

- A harmonized child dummy capable of reproducing human posture and motion in a realistic vehicle environment is needed.
- Test programs should explore alternative test methods.
- Reliance on minimum requirements and the associated test methodologies may not be conducive for the development or for the optimization of child safety.
Future work

Additional paired comparisons conducted in a vehicle buck at lower impact speeds and regulatory-like tests using the proposed FMVSS 213 sled buck.
Canada Goose- Foldable
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