Review of Seatbelt Anchorage and Dimensions of Test Bench Seat Cushion

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Motivation and Purpose

• There is no definition about whether seatbelt anchorage should be fixed or not.

• We tested the same test conditions except for that the ISOFIX anchorage is fixed or movable, and the injury measures of a dummy were compared.
  – From those results, we reviewed that the seatbelt anchorage should be fixed or movable.
Side Impact Test Methods

- We used acceleration type sled test system
- We used Q3 dummy
- We tested 2 kinds of ISOFIX type CRS
CRS

CRS-A

CRS-B
Door Velocity, and Relative Velocity between Door and Seat

- The door velocities were in Corridor
- The relative velocities when ISOFIX anchorage fixed were out of corridor after 50ms, but it was the time after the maximum dummy injury measures. So we think it was not influenced to the comparisons.
Test Video of CRS-A

Movable ISOFIX anchorage

Fixed ISOFIX anchorage
Dummy Accelerations (CRS-A)

Head Acceleration

Chest Acceleration

Pelvis Acceleration

- Movable ISOFIX anchorage
- Fixed ISOFIX anchorage
Test Video of CRS-B

Movable ISOFIX anchorage

Fixed ISOFIX anchorage
Dummy Accelerations (CRS-B)

**Head Acceleration**

**Chest Acceleration**

**Pelvis Acceleration**

- **Movable ISOFIX anchorage**
- **Fixed ISOFIX anchorage**
## Maximum Dummy Injury Measures

<table>
<thead>
<tr>
<th>Region</th>
<th>Injury measure</th>
<th>Unit</th>
<th>Threshold</th>
<th>CRS-A</th>
<th>CRS-B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ISOFIX Anchorage</td>
<td>Movable</td>
<td>Fixed</td>
</tr>
<tr>
<td>Head</td>
<td>HPC15</td>
<td>—</td>
<td>—</td>
<td>523</td>
<td>533</td>
</tr>
<tr>
<td></td>
<td>3ms Acceleration</td>
<td>G</td>
<td>—</td>
<td>81.5</td>
<td>82.6</td>
</tr>
<tr>
<td>Chest</td>
<td>Chest deflection</td>
<td>mm</td>
<td>—</td>
<td>18.9</td>
<td>16.1</td>
</tr>
<tr>
<td></td>
<td>3ms Acceleration</td>
<td>G</td>
<td>—</td>
<td>47.1</td>
<td>47.9</td>
</tr>
<tr>
<td>Pelvis</td>
<td>3ms Acceleration</td>
<td>G</td>
<td>—</td>
<td>83.5</td>
<td>89.5</td>
</tr>
<tr>
<td>Photos of CRS Before / After Test (CRS-A)</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>------------------------------------------</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Movable ISOFIX anchorage</strong></td>
<td><strong>Fixed ISOFIX anchorage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Before</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image1" alt="Before Movable ISOFIX anchorage" /></td>
<td><img src="image2" alt="Before Fixed ISOFIX anchorage" /></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>After</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image3" alt="After Movable ISOFIX anchorage" /></td>
<td><img src="image4" alt="After Fixed ISOFIX anchorage" /></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Photos of CRS Before / After Test (CRS-B)

<table>
<thead>
<tr>
<th></th>
<th>Movable ISOFIX anchorage</th>
<th>Fixed ISOFIX anchorage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before</strong></td>
<td><img src="image1" alt="Before Movable ISOFIX" /></td>
<td><img src="image2" alt="Before Fixed ISOFIX" /></td>
</tr>
<tr>
<td><strong>After</strong></td>
<td><img src="image3" alt="After Movable ISOFIX" /></td>
<td><img src="image4" alt="After Fixed ISOFIX" /></td>
</tr>
</tbody>
</table>
Photos of ISOFIX Connector after Tests

Fixed ISOFIX anchorage

<table>
<thead>
<tr>
<th>CRS-A</th>
<th>CRS-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image of CRS-A]</td>
<td>![Image of CRS-B]</td>
</tr>
<tr>
<td>![Image of CRS-A]</td>
<td>![Image of CRS-B]</td>
</tr>
</tbody>
</table>
Photos of ISOFIX Connector after Tests

Fixed ISOFIX anchorage (CRS-A)

ISOFIX connector was broken.
Conclusion about ISOFIX Anchorage

• Injury measures under conditions that the ISOFIX anchorage was fixed and movable were almost similar.
• There were cases that ISOFIX connector lever could not be moved when ISOFIX anchorages were fixed, so we could not release the ISOFIX connector and it took a long time to remove a CRS from the test bench seat.
  – It was easy to remove a CRS from the ISOFIX anchorage when the ISOFIX anchorages were movable.

We think it is better that the ISOFIX anchorage is movable.
Side Impact Test Methods

- We used acceleration type sled test system
- We used Q3 dummy
- We tested CRS fixed by seatbelt
Conclusion about Seatbelt Anchorage

• It was easy to remove CRS fixed by seatbelt from test bench seat.
• A movable seatbelt anchorage may make structure of the jig complex.

It is considered that a fixed seatbelt anchorage is an advantage because the different between fixed and movable anchorages has a small effect on injury measures.
• There are cutouts in a seat defined in the new regulation.
• The difference between fixed and movable anchorages has a small effect on injury measures.
  – Injury measures are almost the same regardless of a distance when a CRS moves on a seat. There is no influence of friction.
A seat shape has a small effect.

We think it is better that a seat shape is simple because it is easy to make the cushion, for example, like the shape defined in UN.
Dimensions of Test Bench Seat Cushion for Side Impact

- \( T=0 \text{ms} \) is defined when a door surface reaches the position of 350mm from the center of a CRS.
- \( T=0 \text{ms} \) is the time when a door reaches the position of 50mm from a seat end.
Setting of $T=0\text{ms}$ for Side Impact Test

- It is easier to set $T=0\text{ms}$ for the time when a door reaches a seat end than the time when a door reaches the position of 50mm from a seat end.
- We think it is better that the center of a CRS is the position of 350mm from a seat end for the seat cushion of side impact test.
• The center of a CRS is located between 350mm and 400mm from a seat end. (Only for side impact test)