Item 15 of the provisional Agenda
Regulation 44
Proposal for Supplement 7 to the 04 series of amendments
Submitted by the expert from France

Geneva, 11 December 2012
Objectives

- Clarify lap-strap interaction with the dummy
- How to assess that interaction
- Improving the overturning test
Paragraph 2.8.1., amend to read:

2.8.1. "lap strap" means a strap which, either in the form of a complete belt or in the form of a component of such a belt, passes across the front of, and restrains, directly or not, the child's pelvic region pelvis;

A more precise wording to define the lap strap role in restraining the pelvis of the dummy
Paragraph 6.2.1.5., amend to read:

"6.2.1.5. For all forward-facing group I restraints incorporating an integral harness belt system to prevent submarining, either by impact or through restlessness, a crotch strap shall be required. On all forward-facing group I restraints incorporating an integral harness belt system. With the crotch strap attached, and in its longest position if adjustable, it shall not be possible to adjust the lap strap to lie above the pelvis in either the 9 kg or the 15 kg dummy."
Paragraph 6.2.2., amend to read:

"6.2.2. For groups I, II and III, all restraint devices utilizing a "lap strap" must positively guide the "lap strap" to ensure that the loads transmitted by the "lap strap" are transmitted through the pelvis. The assembly shall not subject weak parts of the child's body (abdomen, crotch, etc.) to excessive stresses."
Insert new paragraphs 6.2.2.1. and 6.2.2.2., to read:

"6.2.2.1. With the crotch strap attached, and in its longest position if adjustable, it shall not be possible to adjust the lap strap to lie above the pelvis of both the smallest and largest dummy within the mass groups covered by the approval. For all forward-facing restraints, it shall not be possible to adjust the lap strap to lie above the pelvis of both the smallest and largest dummy within the mass groups covered by the approval."

6.2.2.2. During the dynamic test, as prescribed in paragraph 8.1.3., the lap belt shall not wholly pass beyond or move over the pelvic structure of the dummy, during the period prior to maximum horizontal head excursion. Assessment shall be carried out using high speed camera."
Paragraph 6.2.4., amend to read:

"6.2.4. The assembly shall not subject weak parts of the child's body (abdomen, crotch, etc.) to excessive stresses. The design shall be such that compression loads shall not be imposed on the crown of the child's head in the event of a collision."
Overturning Test according to ECE R44

7.1.3. Overturning
7.1.3.1. The child restraint shall be tested as prescribed in paragraph 8.1.2.; the manikin shall not fall out of the device and, when the test seat is in the upside down position the manikin's head shall not move more than 300 mm from its original position in a vertical direction relative to the test seat.

8.1.2. Overturning
8.1.2.1. The manikin shall be placed in the restraints installed in accordance with this Regulation and taking into account the manufacturer's instructions and with the standard slack as specified in paragraph 8.1.3.6. below.
8.1.2.2. The restraint shall be fastened to the test seat or vehicle seat. The whole seat shall be rotated around a horizontal axis contained in the median longitudinal plane of the seat through an angle of 360° at a speed of 2-5 degrees/second. For the purposes of this test, devices intended for use in specific cars may be attached to the test seat described in Annex 6.
8.1.2.3. This test shall be carried out again rotating in the reverse direction after having replaced, if necessary, the manikin in its initial position. With the rotational axis in the horizontal plane and at 90° to that of the two earlier tests, the procedure shall be repeated in the two directions of rotation.
8.1.2.4. These tests shall be carried out using both the smallest and the largest appropriate manikin of the group or groups for which the restraining device is intended.
Test Description, overturning test today

- Today, the overturning test is a simple rotation (360°) of the dummy in the test seat as shown on the pictures.

- Criteria: The manikin shall not fall out of the device and, when the test seat is in the upside down position. The manikin's head shall not move more than 300 mm from its original position in a vertical direction relative to the test seat.
UTAC Roll Over Tests – Test 1

- Small size vehicle
- 47 km/h initial speed
- Shield system G I
Rollover Tests – Test 1

Before

After the rollover
Test 1 – Motion sequence of the ejection

As the rolling of the car progresses the gap between the occupant and the shield increases, thus no vertical restraint is available.

1st Turn

2nd Turn

Ejection event
UTAC Rollover Tests – Test 2

Mid size vehicle
47 km/h initial speed
Same Shield System as 1st Test
Test 2 - Motion sequence

1st Turn

2nd Turn
What do these tests mean?

- This may pose a safety problem in real world
- Not only in rollover but in other collisions where absence of shoulder restraint may be critical to control occupant containment
- Need to adopt a conservative measure to reduce risk of ejection
Overturning Test according to ECE R44- Comparing Shield & Harnessed Seat

360° @ 2-5 Deg/s: no difference between the 2 systems
Review of § 7 3 1 – Overturning test

7 3 1 does not reflect loading of the CRS and the occupant during an accident

Need for a revision of 7 3 1
Paragraph 7.1.3.1., amend to read:

"7.1.3.1. The child restraint shall be tested as prescribed in paragraph 8.1.2.; the manikin shall not fall out of the device during the whole test and, when the test seat is in the upside down position the manikin's head shall not move more than 300 mm from its original position in a vertical direction relative to the test seat."

Make sure complete test phases are covered
Paragraph 8.1.2.2., amend to read:

"8.1.2.2. The restraint shall be fastened to the test seat or vehicle seat. The whole seat shall be rotated around a horizontal axis, contained in the median longitudinal plane of the seat through an angle of 360° 540° +/- 5° at a speed of 2-5 degrees/second and stopped in this position. For the purposes of this test, devices intended for use in specific cars may be attached to the test seat described in Annex 6."

540° rotation corresponds to 1 and ½ turn
"8.1.2.3. At this static inverted position a total mass equivalent to [5] times that of the dummy shall be applied vertically downwards in a plane perpendicular to the axis of rotation to the dummy utilizing the load application device described in Annex 23. The load shall be applied at a rate not exceeding [400 mm/min]. Maintain the prescribed maximum load for a duration of [30 -0/+5] seconds.

8.1.2.4. Remove the load at a rate not exceeding [400] mm/min and measure displacement.

8.1.2.5. Rotate the whole seat for 180° to return to the starting position."
Paragraph 8.1.2.3 and 8.1.2.4 (former), renumber as paragraphs 8.1.2.6 and 8.1.2.7. and amend to read:

"8.1.2.36. This test cycle shall be carried out again rotating in the reverse direction. after having replaced, if necessary, the manikin in its initial position. With the rotational axis in the horizontal plane and at 90° to that of the two earlier tests, the procedure shall be repeated in the two directions of rotation.

8.1.2.47. These tests shall be carried out using both the smallest and the largest appropriate manikin of the group or groups for which the restraining device is intended.

Any adjustment of the dummy or child restraint systems during the complete test cycle is not allowed."
Test Description, overturning test tomorrow (proposal)

- The rotation angle will be increased to 540°, so that test seat and dummy stop in the upside down position.
- In this position a weight is applied as shown and described on the following slide
- Criteria remains unchanged
1.) 540° rollover test

2.) Attachment of additional weight (4 times dummy mass)

3.) Load applied at less than 400mm/min for 30 s – check of max head displacement

For proper working and testing: Approx. 800mm distance needed between dummy head and floor!
Test Procedure - Videos

Overturning Test with Shield System

Overturning Test with 5-PT-Harness System
Justification of Overturning Pull Force

Vehicle Roll Over Test

Start                     1st Roll                2nd Roll

Vertical chest acceleration
Roof contact at ejection

ECE R44 Overturning Test

Pull force = 4 times dummy mass + origin dummy mass
5g Limit
5g applied to restraint device
Several different shield, as well as integrated harness child restraint systems were tested following the new protocol. Below shown test results are representative and applicable for any CRS model.

**Test Report**

<table>
<thead>
<tr>
<th>CRS</th>
<th>DUMMY</th>
<th>ORIENTATION</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shield</td>
<td>P3</td>
<td>1</td>
<td>Pass - 250mm max displacement</td>
</tr>
<tr>
<td>Shield</td>
<td>P3</td>
<td>2</td>
<td>Pass - 25mm max displacement</td>
</tr>
<tr>
<td>Shield</td>
<td>P3</td>
<td>3</td>
<td>Fail - dummy ejection</td>
</tr>
<tr>
<td>Shield</td>
<td>P3</td>
<td>4</td>
<td>Pass - 25mm max displacement</td>
</tr>
<tr>
<td>Shield</td>
<td>P3/4</td>
<td>1</td>
<td>Pass - 30mm max displacement</td>
</tr>
<tr>
<td>Shield</td>
<td>P3/4</td>
<td>2</td>
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<td>Shield</td>
<td>P3/4</td>
<td>4</td>
<td>Pass - 30mm max displacement</td>
</tr>
<tr>
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<td>P3</td>
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<td>P3/4</td>
<td>4</td>
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</tr>
</tbody>
</table>
7.13. Overturing

7.13.1. The child restraint shall be tested as prescribed in paragraph 8.1.2; the manikin shall not fall out of the device during the whole test and, when the test seat is in the upside down position, the manikin’s head shall not move more than 300 mm from its original position in a vertical direction relative to the test seat.

8.12. Overturing

8.12.1. The manikin shall be equipped with the load application device as described in Annex 23 and placed in the restrainers installed in accordance with this Regulation and taking into account the manufacturer’s instructions and with the standard slack as specified in paragraph 8.13.6, below.

8.12.2. The restraint shall be fastened to the test seat or vehicle seat. The whole seat shall be rotated around a horizontal axis, contained in the median longitudinal plane of the seat through an angle of $400 \pm 5^\circ$ at a speed of 2.5 degrees/second and stopped in this position. For the purposes of this test, devices intended for use in specific cars may be attached to the test seat described in Annex 6.

8.12.3. At this static inverted position a total mass equivalent to 5 times that of the dummy shall be applied vertically downwards in a plane perpendicular to the axis of rotation to the dummy, utilising the load application device described in Annex 23. The load shall be applied at a rate not exceeding [400 mm/min]· gravitational acceleration or 400mm/min.

8.12.4. Remove the load at a rate not exceeding [400 mm/min] and measure displacement.

8.12.5. Rotate the whole seat for 180° to return to the starting position.

8.12.36. This test cycle shall be carried out again rotating in the reverse direction, after having replaced, if necessary, the manikin in its initial position. With the rotational axis in the horizontal plane and at 90° to that of the two earlier tests, the procedure shall be repeated in the two directions of rotation.

8.12.47. These tests shall be carried out using both the smallest and the largest appropriate manikin of the group or groups for which the restraining device is intended. Any adjustment of the dummy or CRS during the complete test cycle is not allowed.

- should be changed

…with the standard slack as specified in paragraph 8.1.3.6 below, applied for all systems identically.

…a total mass equivalent to 4 times that of the dummy shall be applied vertically downwards…..rotation in addition to the dummy……

…applied in a gradual controlled manner at a rate not exceeding [400 mm/min]· gravitational acceleration or 400mm/min……

- comment

…The test will have been deemed a failure and therefore stopped if the 300 mm displacement has been exceeded at any stage of the test cycle.
Summary for improvement of the overturning test

→ Understanding and application of test procedure confirmed by two test labs.

→ Test procedure applied to already existing ECE R44 Roll Over test rig.

→ Test procedure sufficient to recognize poor performing systems in respect to risk of occupant ejection.

→ Minor editorial work to be done on the text, as well as adding a slight geometrical improvement to the load application device, based on feedback from test labs.

An update of formal document 2012-21 is provided for examination by GRSP.
Insert a new Annex 23, to read:

Load application device for Group 0/0+
Test Description – Interpretation/Clarification (Group 0/0+)
Insert a new Annex 23, to read:

Load application device for Group 1
Test Description – Interpretation/Clarification (Group 1)
1. **Paragraph 2.8.1.**: Consistency with paragraph 6.2.2 and clarification of the meaning of "lap strap" in relation to devices used to restrain the child and ensure loading through the pelvis.

2. **Paragraph 6.2.1.5.**: Deals with submarining, while the second part of the paragraph covers requirement of lap strap position which is considered more relevant to paragraph 6.2.2. Assessment test method has been also clarified.

3. **Paragraph 6.2.2.**: Deals with effective lap belt positioning. Requirements about this item have been removed from 6.2.1.5 and 6.2.4 and collected in one paragraph. Due to complexity of the verification assessment, two subparagraphs have been prepared: 6.2.2.1 provides guidance for the static assessment of lap strap positioning, while 6.2.2.2 deals with dynamic assessment. Consequently also 6.2.4 has been modified.

4. **Paragraphs 7.1.3. to 8.1.2.7. and Annex 23**: The present test procedure does not adequately reflect the circumstances of real world rollover crashes. The procedure has been improved to reduce the existing differences between the test procedure and real accidents. A vertical quasi-static load is applied to simulate the dynamic behaviour of the child restraint systems and the dummy.