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PROPOSAL FOR DRAFT AMENDMENTS TO REGULATION No. 44
(Child restraint systems)

Transmitted by the expert from the European Association of Automotive Suppliers (CLEPA)

Note: The text reproduced below was prepared by the expert from CLEPA in order to amend the Regulation with regard to the horizontal plane requirement of 800 mm. It is based on a document without a symbol (informal document No. GRSP-38-9), distributed during the thirty-eighth session of GRSP (see report TRANS/WP.29/GRSP/38, para. 25).

The modifications to the current text of the Regulation are marked in **bold** characters.

Note: This document is distributed to the Experts on Passive Safety only.

A. PROPOSAL

Paragraph 7.1.4.4.1.1., Figure 1, amend the value "800" to read "**900**".

Paragraph 7.1.4.4.1.2.1., Figure 2, amend the value "800" to read "**900**".

Paragraph 7.1.4.4.1.2.2., Figure 3, amend the value "800" to read "**900**".

Paragraph 7.1.4.4.1.2.3., Figure 4, amend the value "800" to read "**900**".

B. JUSTIFICATION

The extension of the 800 mm plane requirement to a value of 900 mm would allow:

1. more space for the child's leg for the group 1 rear facing seat, which will enable an extended use of this type of seat;
2. a consistency with vehicle space available for adult occupants at or above the 50^o percentile population;
3. more design options for the larger child population and better belt positioning of the smaller child without compromising the safety, as the proposed change (+100 mm) remains consistent with the requirement of paragraph 7.1.3.1. which in fact accepts +300 mm head vertical excursion.

The analysis and data supporting the requested change are presented in the rest of this document.

Investigations into the 800 mm Horizontal Plane Requirement in Regulation No. 44/03

Introduction

The 800 mm horizontal plane requirement is described in paragraph 7.1.4.4. in UNECE Regulation No. 44. It requires that for both rear facing and forward facing child restraints the dummy's head should move below this plane for the entire duration of the test (300 ms). The 800 mm limit plane was introduced in Regulation No. 44 at the time where no specifications existed for roll over test, called also overturning. The background data was generated from measurements on vehicles in order to establish a zone for which a contact between the child's head and the vehicle interior can be avoided.

The subject of the present study is to highlight some problems generated by this requirement, which with present technology of vehicles and child restraint systems (CRS) seems to be outdated and is generating important limitations in designing.

Limitation of design in the case of Group 1 rear facing CRS

An in-car evaluation was carried out on products used in Scandinavian countries. The seat was installed in the rear seat of a European family car with 2 positions as shown in Figure 1 below: Position A with the CRS in full contact with the vehicle seat back (no room for the child's legs)

and position B where the CRS was moved 100 mm forward. This last position represents in fact a 100 mm space for the child's legs. In both positions the available space between the top of the CRS and the 800 mm plane was measured. The values are 80 and 55 mm respectively for position A and B. This type of seat is approved for Group 2 (P6) with the top of the dummy's head normally protruding by 25 mm, which again reduces the distance of the head with respect to the 800 mm plane.

In case of rear impact the dummy, while moving rearward, can rotate within the harness and this can cause the head to become close to the 800 mm limit. This shows the reduction of available head clearance against the effects of adding room for the child's feet. Due to this constraint the foot clearance for this type of CRS is limited. Thus an extension of the 800 mm plane will help to address this problem.



CRS position A:

The CRS is positioned in full contact with the vehicle seat back. The resulting distance between the top of the CRS and the 800 mm limit is 80 mm.



CRS position B:

The CRS is positioned 100 mm forward from the vehicle seat back. The resulting distance between the top of the CRS and the 800 mm limit is 55 mm.

Figure 1: Positions of a Group 1,2 rear facing child seat with respect to 800 mm horizontal plane.

800 mm plane and the 50 percentile adult dummy

A physical study, using test manikins on the test bench as defined Regulation No. 44, 03series of amendments, was then conducted to compare the relative head positions of the Hybrid II 50th percentile and the P10 dummies with respect to the 800 mm plane. This plane was materialized using a laser pointer as shown in Figure 2.



Installation of the Hybrid II dummy on the sled test bench as defined in Regulation No. 44.



Laser point indicating the 800 mm height

Red Laser point sets to 800mm from Cr axes. Maximum vertical height from Cr axes to the top of the 50th percentile head is 882mm

Figure 2: Measurement of the Hybrid II 50th percentile dummy head position with respect to the 800 mm plane.

It was found that the top of the head of the Hybrid II dummy is located 882 mm above the Cr point, i.e. 82 mm above the 800 mm plane whilst the top of the head of the P10 dummy was 710 mm, without tensioning the belt system. This measurement shows an inconsistency of the 800 mm requirement as it is well below the top of the head of an average adult male. If we consider a 95th percentile male then the situation becomes worse. There is therefore a need to adapt the 800 mm plane to occupant space available in vehicles.

Booster seat design requirements and the 800 mm plane

It is known that one of the primary design goals for a booster seat is to raise the child position, and in particular the pelvic position in order to have an effective restraint with the adult belt in case of an accident. To illustrate this, an investigation was carried out including the measurement of the pelvic position for child dummies P3, P6 and P10 and also the Hybrid II 50th percentile dummy, as shown in Figure 3. All measurements were expressed in relation to Cr point along a vertical axis.



Vertical Pelvic position at load bearing point of Hybrid 2 - 50th from Cr axes. Recorded distance is (191 mm)



Comparison of pelvic position of P10 and 50th percentile adult male dummies. Recorded pelvis vertical measurement was 34 mm lower for the P10.

Figure 3: Measurement of vertical distance between belt load bearing point and Cr point of a Regulation No. 44 sled bench for an adult 50th percentile dummy and a 10 year old dummy.

The height of the pelvic load bearing point measured for the Hybrid II and the P10 was 191 mm and 157 mm respectively. The same measurement was carried out with P3 and P6 dummies. The corresponding height of the load bearing point of these dummies was 147 mm and 121 mm respectively for P6 and P3. This indicates for instance that the pelvic position of a 3 year old child with regards to the adult belt can be considered to be 70 mm lower than that of a 50th percentile adult (Figure 4).



Figure 4: P3 without Booster CRS. Pelvic load bearing point is 121m above Cr.

As the objective of using a booster seat is to raise the pelvis of a child to the same position of that of an adult the results above show that the minimum distance needed to reach this position is 70 mm for the smallest dummy. For group 2 and 3 of Regulation No. 44, the type of restraints this shows also the need to raise the P10 dummy by a minimum of 70 mm, which means that the top of the head for this dummy will reach 780 mm with respect to Cr point, i.e. 20 mm below the 800 mm plane. This offers a very small margin for design options and innovations for the population covered by P10 dummy. As for the previous cases this investigation also calls for an increase of the 800 mm plane.

Overturning Test

The purpose of this requirement is to provide a control of the occupant's vertical displacement during a vehicle rollover. It allows for a movement of 300 mm from the initial installed static position. The requirements for this test are described in paragraph 7.1.3.1.:

"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."

If a P10 dummy on a booster CRS records an initial 800 mm, it can, therefore, move 300 mm and shows an overall position of 1100 mm and still be considered acceptable. This overturning requirement appears to be in contradiction with the requirement of the dynamic vertical pass/fail threshold. Therefore, there is a need to have consistent requirements between the two aspects, the 800 mm horizontal plane and the overturning test.

Recommendation

Based on the present study it is recommended to extend the 800 mm plane requirement to a value of 900 mm. This would allow:

1. More space for the child's leg for the group 1 rear facing seat, which will enable an extended use of this type of seat;
2. A consistency with vehicle space available for adult occupants at or above the 50th percentile population;
3. More design options for the larger child population and better belt positioning of the smaller child without compromising the safety, as the proposed change (+100 mm) remains consistent with the requirement of paragraph 7.1.3.1. which in fact accepts +300 mm head vertical excursion.

Reference Data

For Hybrid II 50th Percentile information, see the following website address:

<http://www.ftss.com/pcat/products.cfm?obr=NS&bm=1&pcat=h2-50m>
