

Special meeting of the GRSP Informal Group on UNECE R29 - Cab Strength

10 - 11 April 2007

1. PARTICIPANTS:

See document GRSP-INF-CS-1. Mr van der Straaten (OICA) chaired the meeting.

2. ADOPTION OF THE AGENDA

The agenda was adopted without any comment

3. INTRODUCTION ON RENAULT TRUCKS ACTIVITIES AND FACILITIES

On 10 April, the group received some presentations on the Renault/Volvo endurance and reliability testing programs, as well as some information regarding the safety testing. A visit of the proving grounds was also arranged.

4. REVIEW OF PURPOSE OF MEETING, FOLLOWING DISCUSSIONS AT GRSP

Document: TRANS/WP29/GRSP/40, § 30 - 34

The group recalled the discussions at the December 06 GRSP session, where it was agreed to resume the activities on the further development of UNECE R29, as a possible first step for the later development of a global technical regulation under the 1998 Agreement. It was agreed that this current meeting should review available accident data in order to define the most relevant real world accident scenarios. In a second phase, the appropriate test procedures would then be developed in order to best reproduce real life accidents.

5. REVIEW OF AVAILABLE ACCIDENT DATA

5.1 USA - see GRSP-INF-CS-2

Mr Geiger (OICA) presented the accident studies conducted in the USA, based on various databases - see GRSP-INF-CS-2. The following highlights were noted:

- Though representing only about 20% of the annual sales in the US, heavy trucks over 15,000 kg represented about 83% of the observed truck fatalities; vehicles below 15,000 kg represent only a very minor part of the fatalities
- Cluster analysis on the basis of the FARS data indicated 3 major accident modes: rollover, collision with fixed objects, collision with other motor vehicles. The collisions are generally frontal and rollovers are very harmful events, regardless of the cab style (conventional or Cab Over Engine)
- Detailed studies from the National Transportation Safety Board generally confirm the studies on the basis of the FARS database, resulting in 6 major accident modes identified: head-on collisions (front to front), rear end collisions (front to rear), collisions with fixed objects, 90° rollover with and without subsequent collision, 180° rollover.
- Though the fatality ratio has decreased by more than 50% over the last 30 years, accident modes with fatalities are believed to remain unchanged
- Current belt wearing rates in truck in the US are at about 50%, a clear increase compared to 20 years ago

Mr Geiger concluded his presentation by reviewing in detail the various critical accident modes, and the following remarks were made:

- Head-on collisions (front to front) show a rather large offset and often extremely high energy levels and deformations. The group agreed that such accidents can be considered as "catastrophic", where passive safety measures are unlikely to result in any benefit
- Collisions with fixed objects: the same remarks as for the head-on collisions apply here and the group agreed that also such accidents may be catastrophic
- Rear end collisions (front against rear of preceding vehicle): data show that overlap is usually high (up to 100%) and the current R29 frontal test is a simulation of such frequent accident mode
- 90° rollover: when no subsequent impact occurs, cab deformations are generally very low. The group agreed that such situation did not necessitate any regulatory action. When there is subsequent collision, the situation may however be critical and the current Swedish A-pillar test aims at reproducing such situation. This accident scenario is also taken into account by OICA.
- 180° rollover: the group recognised that this scenario may also be critical, resulting in high roof deformations.

During the subsequent discussion, the importance of safety belt wearing was repeatedly highlighted, especially in view of the need to prevent ejection of the occupant(s).

5.2 Europe - see GRSP-INF-CS-3 and GRSP-INF-CS-4

Mr Foucher (OICA) presented the accident studies made by Volvo - GRSP-INF-CS-3 - on the basis of 455 traffic accidents with injured truck drivers, concluding that rollover is involved one way or another in 68% of the accidents with injuries. This rollover also results in a deformation of the upper A-pillar in 21% of all accidents in the sample. The presentation also contains examples showing the typical cab deformation patterns.

Mr Foucher noted that these studies also confirmed the US data, in that the rollover with subsequent impact was quite a harmful situation.

Mr Foucher then also presented a detailed analysis made by CEESAR (French research institute), with detailed studies of several truck accidents - see GRSP-INF-CS-4.

During the following discussion, the following main comments were made:

- In the Volvo study, all cabs met the current Swedish requirements; the examples given however indicate excessive deformations. The group however noted that most of these examples are extremely severe accidents and that in any case passive safety measures need to be limited to what is physically possible.
- Conventional or COE designs show no difference in the rollover scenario. Conventional designs however have a clear advantage in frontal impacts, since there is virtually no cab deformation in a front impact.

5.3 Japan -see GRSP-INF-CS-5

Mr Sukegawa (Japan) gave an overview of truck accidents in Japan (see GRSP-INF-CS-5). Classification of the accidents shows a pre-dominance of rear end collisions (front to rear). Studies were also made on the various body regions injured and the effect of safety belts. Detailed analysis of 55 accidents with rollovers show that injuries are present in 31 % of the cases (there was no injury in 47% of the cases); furthermore, a large majority (87%) were 90° rollovers, 180° rollovers representing only 4%. Cab deformation as a result of a 90° rollover is rather minor in 34% of the cases, but upper A-pillar deformation was seen in 21% (confirming the Volvo data).

Mr Sukegawa concluded that, in Japan, frontal impacts (especially front to rear) are the most important, rollover representing only a minor injury causation accident.

During the following discussions, some experts suggested that the low rollover data in Japan might be caused by the size of the sample and the fact that this small sample also contains cases without injuries; according to US and European data, rollover (90° with subsequent impact and 180°) is clearly seen as a major injury causation factor: when such rollover occurs, injuries may be frequent. Some other experts pointed out that the road infrastructure in Japan may be different, such that the frequency of rollover is lower.

5.4 Others

Mr Riabchinsky (Russian Federation) pointed to a paper distributed to GRSP quite some time ago, also stressing the importance of frontal collisions and rollovers. An analysis was made of the performance of conventional design versus COE (Cab Over Engine), for vehicles just meeting the UNECE R29 requirements. According to this analysis, conventional designs are clearly safer, as well as vehicles with a safety bar (rollover bar between cab and cargo area), resulting in lower deformations and injuries.

The group however noted that any regulation should remain performance oriented, not dictating any particular design; moreover, other regulations such as those on maximum length and mass need to be balanced with economical considerations.

The group consequently agreed not to regulate the design of vehicles and to concentrate on performance requirements.

Subsequent note; the paper mentioned by Mr Riabchinsky was distributed as informal document 24 at GRSP-28 (Dec 2000). Since it is not available anymore on the GRSP web site, this paper is reproduced as GRSP-INF-CS-6 and the following highlights can be noted:

- *Accidents resulting in truck occupant injuries are frontal collisions (73%) and rollovers (24%)*
- *Highest number of accidents with fatalities or injuries are with heavy vehicles of the N3 category (vehicles over 12 tonnes)*

6. REVIEW OF MOST RELEVANT ACCIDENT SCENARIOS

Following study of above statistics, the group agreed with the following conclusions:

- Most important accidents in terms of fatalities/injuries are frontal impacts and rollovers.
- For frontal impacts, both front/front and front/rear are important
- Front/front impacts (head-on collisions) display large offset (> 50%), such that only a part of the cab width is involved in the accident
- Front/front impacts usually result in extremely high energy levels and deformations, such that these can be classified as "catastrophic". The group agreed not to concentrate on such configuration.
- For front/rear impacts (front of truck colliding with rear of preceding vehicle), overlap is usually high (up to 100%), involving the whole cab width. This accident configuration is in fact addressed by the current UNECE R29 frontal impact test
- Rollovers can be divided into 90° and 180°
- 90° rollovers without subsequent impact generally result in minor cab damage and can therefore be neglected. They are only relevant when the vehicle continues to rollover up to 180°, since the first 90° result in a transversal load on the roof
- 90° rollovers with sliding and subsequent impact are important and result in a longitudinal load on the upper part of the A-pillar
- 180° rollovers, even though apparently not very frequent in Japan, may result in substantial cab deformation and injuries. Such rollovers have a 90° rollover as a first step, thereby laterally loading the roof structure before the vertical crushing.

In conclusion, the group agreed to retain as most important accident scenarios for the evaluation of the cab strength:

- a) Front/rear impact
- b) 90° rollover with sliding and possibly subsequent impact
- c) 180° rollover

Laboratory test procedures to evaluate cab strength should aim at reproducing these accident configurations. The group also agreed that sufficient flexibility should be maintained by allowing alternative test methods, provided they are equivalent in terms of energy and impact location/direction.

Mr Gerlach (Germany) pointed out that the test procedures and requirements should avoid the need for further excessive stiffening of the cabs.

7. REVIEW OF PROPOSALS TO AMEND UNECE REGULATION N° 29

Documents: TRANS/WP29/GRSP/2007/2 (OICA)
TRANS/WP29/GRSP/2006/5 (Russian Federation)
GRSP-INF-CS-7 (Russian Federation)
GRSP-INF-CS-8 (Czech Republic)

GRSP-INF-CS-8, giving some comments to the OICA proposal was distributed, but not reviewed.

On the basis of GRSP-INF-CS-7, the group briefly reviewed the main principles of the various existing proposals, with the following main comments:

7.1 Front/rear impact

While the OICA proposal follows the current UNECE R29 approach, but with higher energy levels, Russia proposes an offset test, considering this is the most frequent accident configuration. As an alternative, the impact energy level should be increased, to be in line with that seen for cars in a frontal impact. Other experts however pointed out that, as noted above, the front/rear impact is usually with a very high overlap. Even if there is an escape manoeuvre, resulting in offset, the differential speed would be much lower than in a head-on collision, thereby strongly reducing the energy level. In any case, energy levels as seen in car frontal impacts would be totally unrealistic for trucks¹.

The Russian Federation however noted that the offset test would ensure higher safety levels and considered that its proposal (40% overlap and 40 kJ) would, in the OICA test (full width), result in 80 to 100 kJ energy. Mr Riabchinsky further informed that tests according to the Russian proposal have already been performed.

It was agreed to defer further discussion to the next meeting.

7.2 90° rollover with sliding and possibly subsequent impact

The OICA proposal uses the Swedish current test principle, replacing however the round shaped barrel by a flat plane in order to improve repeatability and to better reproduce deformations seen in real world accidents. OICA noted that simulations show that this test is well reproducing real world deformations and that it represents a severity increase of about 20% compared to the Swedish requirements.

The Russian Federation however expressed doubts as to the repeatability of this test²; Mr Geiger noted that various alternatives to the pendulum would be possible, such as an impact jig, shaped as needed, impacting the upper A pillar; another possibility would be to mount the cab on a sled, impacting the shaped impactor; these alternatives are expected to show excellent repeatability.

The group noted that no actual tests have been performed yet to the OICA proposal, which would therefore need to be validated once all the theoretical parameters have been defined.

It was agreed to defer further discussion to the next meeting.

7.3 180° rollover

OICA explained its proposal to split this test into 2 parts³. Part 1 consists in dynamically and transversally pre-loading the roof structure; the following part 2

¹ *The energy mentioned in car crashes is spent in the deformation of both the passenger's compartment and the car's structure; in the present wording of R29, only the cab is involved; moreover the cab is linked to the chassis structure by suspension elements that should not get broken down during the tests*

² *Mainly due to expected difficulties in controlling the movement of the pendulum*

³ *Based on the chronological order of deformation steps observed in real life accidents*

would in effect be the current vertical crush load as per UNECE R29, however performed on the roof pre-deformed by part 1.

The Russian Federation expressed some doubts as to the repeatability of the test, considering that its fully static approach (vertical static load on the inclined cab) would be easier to perform. Mr Geiger pointed out that the OICA proposal is in fact the test used by the US manufacturers since quite some time, with no difficulties having been experienced.

It was agreed to defer further discussion to the next meeting.

8. PREPARATION OF ROADMAP AND TIME SCHEDULE FOR FINALISATION OF PROPOSAL TO GRSP

Due to lack of time, the group could not review this item.

9. DATE AND PLACE OF THE NEXT MEETING

It was agreed that OICA and the Russian Federation would review, during the next GRSP session in Geneva, a possible date for a next meeting.
