

## **Proposal for draft amendments to Regulation No. 66**

### **Summary Document**

Informal Group of UNECE GRSG on Regulation No. 66: Strength of Superstructure

#### **1. Task/terms of reference**

In the course of action to adapt UNECE Regulation No. 66 “Strength of Superstructure” to technical progress, the need was felt to continue the research with regard to the necessity to extend the scope of Regulation No. 66 to other vehicles than the current single-deck rigid or articulated vehicles with more than 22 passengers.

WP.29 decided to hand over this task to an informal group (IG/R66) on basis of the initiative of the European Union, as it seemed more appropriate to concentrate the necessary efforts to a smaller circle than the whole group of GRSG.

The aim of the group is to:

1. Collect and evaluate accident statistics and relevant analyses
2. Define the required protection level for all bus categories in rollover, including small buses and double-deck coaches
3. Propose technical research, if needed
4. Propose the bus categories to be included in the scope, if needed
5. Draft a proposal for modification of the Regulation, as a consequence of item 4
6. Propose other possible action to enhance safety in rollover accidents

The informal group has the responsibility of preparing and bringing forward a possible proposal for an amendment of the scope, if justified by the research and development work done so far by different institutions, and to take account of any additional work that is being undertaken.

#### **2. Regulatory background**

UNECE Regulation No. 66 “Uniform provisions concerning the approval of large passenger vehicles with regard to the strength of their superstructure” came into force in 1986. Though compulsory application started in 1986 through to 1993 in a few countries in Europe, it is now more widely spread throughout the Contracting Parties of the UNECE 1958 Agreement. Whilst the requirements for the different categories of buses and coaches were originally separated into UNECE Regulations Nos. 36, 52 and 107, WP.29 approved the GRSG proposal to align the scope of UNECE Regulation No. 66 with the scope of UNECE Regulation No. 36. Due to the coming into force of EC Directive 2001/85/EC, which contains the same technical requirements as UNECE Regulation No. 66, some of the Member States of the European Union already apply it on a mandatory basis. When Framework Directive 2007/46/EC (EC-WVTA) becomes mandatory for vehicles of categories M2 and M3 many Contracting Parties will be obliged to mandate UNECE Regulation No. 66.

The Australian and South African legislations cover small buses on basis of UNECE Regulation No.66.

In the United States of America there are some efforts to improve safety of motor coaches including strength of superstructure (see Docket NHTSA-2007-28793).

After the introduction of the fitting of safety belts into vehicles of classes III and B, it became evident that the influence of belted passengers on the performance of superstructures, in case of an accident, needed to be examined. The result of this action led to the 01 series of amendments, which came into force in 2005. Compliance is mandatory from 2010 for new ECE Type-approvals.

### **3. Vehicle fleet data**

The informal group decided to collect data on the number of vehicles in service and focused on the ratio of small buses and double-deck vehicles in the total fleet. This data should be incorporated in the process of deciding on the necessity of enlarging the scope of UNECE Regulation No. 66 by evaluating the representation of the different vehicle types in certain accident scenarios. The documents distributed to the members of the informal group give a general overview but show that the different statistics follow very different concepts and mostly do not take into account the UNECE vehicle classification system. Therefore the question of comparability of data needed to be considered.

### **4. Statistics / accident data (1995-to date) / Accident analysis**

A wide range of national and international statistics was collected by the members of the informal group. Further accident analysis by different technical institutes was made available to be discussed and evaluated. Even if bus and coach accidents often lead to a high perception among the public and the media, the reliability of the information as reported by the media with regard to the injury figures, the severity of the injuries, the injury mechanism, etc. seems inappropriate, so this information cannot be used as a basis for this kind of consideration. Therefore the informal group decided to only use those statistics and analyses that did not include media data. To reflect the technical progress only data from 1995 onwards was taken into account.

#### **4.1 Scientific data**

During the course of the meetings, the IG/R66 collected available data on single accidents, accident statistics and analyses of accidents that incorporate small buses and double-deck vehicles, where appropriate in comparison with information on single deck vehicles that are already covered by the scope of UNECE Regulation No. 66.01.

From data showing the total number of rollover accidents involving small buses and double-deck coaches, it was concluded that they do not occur that frequently. There is not enough information to determine on a general level their relevant proportion in rollover accidents compared to their representation in the total in-service fleet.

As mentioned in paragraph 2, UNECE Regulation No. 66 is applied on a mandatory basis in only a few countries. However, some manufacturers apply the Regulation to their vehicles even if they are not obliged to do so; others use the UNECE Regulation No. 66 approval for marketing reasons to show the superior level of safety of their buses or coaches. Looking at rollover accidents and the respective vehicles involved in those accidents, the question of whether the vehicle complies or not with UNECE Regulation No. 66 could not be answered in most cases.

The available statistics are based on very different concepts. Vehicle categories are often defined on the basis of national vehicle classifications, e.g. based on the gross vehicle mass or the engine power of the buses or coaches. Others refer to the number of passengers, but do not use the UNECE classification system. The question how to compare data from different sources cannot be answered satisfactorily.

Consolidation of the documents discussed produced the following questions:

- What is the frequency of bus/coach rollover accidents in relation to other accident types for buses/coaches, and for the vehicle fleet as a whole?
- What is the frequency for each bus/coach type (e.g. single-deck, double-deck, large, small, etc.) involved in rollover accidents?
- What is the frequency for each level of injury for each bus/coach type in rollover accidents?
- By what mechanism are occupants injured in rollover accidents (e.g. thrown around in vehicle, roof crush (protrusion), full or partial ejection, etc.)?

The European project, ECBOS, initiated within the 5th framework research programme of the European Commission, was conducted from the year 2000 on. This research project looked at bus and coach strength of superstructure. The summary report of ECBOS was made available to UNECE GRSG (GRSG-86-4).

ECBOS recommended extending the scope of UNECE Regulation No. 66 to small buses. Regarding double-deck vehicles, ECBOS said in its Summary Report “It is necessary to analyse how resistant the actual designs are and the economical and social impact of including those vehicles inside the requirements of regulations and directives on rollover. That is especially important if the mass of the belted passengers is taken into account, because the increase of the energy to be absorbed during rollover increased with the number of passengers and the height of the centre of gravity”.

Further research is being conducted in APSN. The outcome of the research remains open.

The TRL Report indicates that between 1994 and 2005, 27 double-deck buses and coaches were known to have rolled over in the UK. However, in 27% of rollover cases the body type (single or double-deck) was unknown so it is possible that some additional double-deck rollover accidents occurred during this period. In the 27 double-deck rollover accidents that were reported, 1 person was killed and 242 were injured. The report then analysed all road accidents in the UK during the period 2003 - 2005: a period when double-deck rollover accidents were not severe compared with the overall period, and concluded that "Extension to double deck highly unlikely to be cost beneficial. Zero fatality cases in the time period for analysis". With regards to minibuses the report concluded that "Extension to minibuses may prove cost beneficial but will depend on assessment of effectiveness – lack of seat belt wearing likely to limit effectiveness".

A study of bus and coach accidents that happened in Spain between 1995 and 2004 concluded that whilst rollover/overturning accidents do not happen very often, when they do the number of seriously injured occupants can be high. The database showed that accidents involving M3 category vehicles represented 2% of all accidents and that for accidents involving M3 category vehicles, rollover accidents of intercity buses represented 4%. Of the 8 buses involved in rollover accidents 1 was a double-decker.

An analysis of the vehicle types involved in 105 rollover accidents that took place in Hungary between 2000 and 2006 showed that small buses and high-deck/double-deck buses were over represented. Small buses were involved in 50% of the accidents whereas high-deck/double-deck buses represented 60% of the number of Class II and Class III vehicles involved.

In Germany, the GIDAS database containing 12647 reconstruction of road accidents that took place in the Hanover and Dresden area between 1999 and 2005 showed that only 5 accidents involved large buses in which passengers were injured, of which only 2 involved bus rollover accidents, including one double-decker. 16 passengers were slightly injured in that rollover accident. No severe injuries and no fatalities were reported. The GIDAS database also contains details of 6 accidents involving M2 category, Class B vehicles, of which 3 were rollover accidents. No severe injuries were suffered by the driver or passengers.

Norwegian statistics showed that between 2002 and 2005 there were 33 rollover accidents involving buses of Class II and III in which 5 occupants were killed and 11 seriously injured. During the same period 9 buses of class A and B were involved in rollover accidents with 0 fatalities and only 2 severe injuries.

The CEESAR/Irisbus database containing details of 94 coach accidents showed that rollovers accounted for 43% of these accidents and that the risk of being killed in a double-deck coach was twice as high as in a single deck. A detailed study of the roof structure deformation using 14 rollover accidents, including 2 double-deck coaches, concluded that it is essential that the passengers remain correctly belted within the vehicle and with adequate survival space. In the case of double-deck coaches the majority of passengers killed or seriously injured were in the upper deck: 83% in the case of an accident involving lateral deformation of the roof and 72% in the case of an accident involving roof crush. The LAB database reported on 6 accidents involving fatalities in vehicles of category M2. Only 1 of these accidents was a rollover.

Statistics from the Netherlands concluded that bus and coach transport is the safest form of passenger transport. Between 1987 and 2006, 26 people were killed in buses (0.113% of all road fatalities) and 353 people were hospitalised (0.151% of road accident hospitalisations).

Special consideration was given to the Swedish authority's communication on a single-deck rollover accident in January 2006 which caused 9 passengers to die and 42 to be injured.

## **4.2 Media information**

In cases when a severe accident with a bus or coach does happen, high media attention is given. Therefore, the rollover accident is considered to be one of the most severe road accidents that may happen to coaches.

An analysis of media information on 314 worldwide rollover accidents that took place between 1990 and 2006 showed that Class III vehicles were involved in 43% of rollover accidents and that 41% of these were high-deck/double-deck coaches. In Europe, during this period, 13 double-deck coach rollover accidents were reported. Information on accidents involving small buses has only been collected during the last 4 years and 63 accidents were reported.

In the period between December 2006 and October 2007 the media reported on 4 double-deck rollover accidents that took place in Europe; 13 people were killed and 115 were injured, many seriously.

## **5. Other aspects considered**

The following items were part of the considerations of the IG/R66:

- The frequency of bus/coach rollover accidents in relation to other accident types for buses/coaches, and for the vehicle fleet as a whole.
- The frequency for each bus/coach type (e.g. single-deck, double-deck, large, small, etc.) involved in rollover accidents.
- The frequency for each level of injury for each bus/coach type in rollover accidents.
- The mechanism by which occupants were injured in rollover accidents (e.g. thrown around in vehicle, roof crush (protrusion), full or partial ejection, etc.).
- The deformation mechanism of different superstructures.
- The applicability of the existing approval test methods.

## **6. Conclusions**

### **6.1. Single-deck vehicles not exceeding 22 passengers**

For vehicles of category M2 or M3, class B, [exceeding 16 passengers] the majority of the experts agreed to propose to extend the scope of UNECE Regulation No. 66, because:

- The severity of the recorded accidents indicates risk for the passengers of these vehicles in case of rollover.
- The main injury mechanism indicates that Regulation No. 66 could help in the protection of the passengers by providing an adequate residual space.
- The dynamics of the rollover test will be similar to smaller M3 vehicles.
- The existing approval tests are applicable to M2 vehicles.
- The mechanism of deformation for M2, class B vehicles is similar to that for M3 vehicles

### **6.2. Double-deck vehicles**

For double-deck vehicles of category M3, class II, III and B, the majority of the experts agreed to propose to extend the scope of UNECE Regulation No. 66 and to apply the Regulation on an optional basis for double-deck vehicles, because:

- The fleet of double-deck vehicles of category M3 is small.
- The severity of reported accidents indicates a higher risk for the passengers of these vehicles in case of rollover.
- The main injury mechanism indicates that Regulation No. 66 could help in the protection of the passengers.
- The dynamics of the rollover test will be similar to single-deck high deck vehicles
- The existing approval tests can be applied to double-deck vehicles
- The mechanism of deformation will be similar to single-deck vehicles.
- Special consideration should be given to the possible increase in the height of the centre of gravity resulting from the reinforcement of the superstructure and to a possible change in the associated stability of the vehicle.

## **7. Recommendation to GRSG**

For vehicles of category M2 or M3, class B, [exceeding 16 passengers] the majority of the experts propose to extend the scope of UNECE Regulation No. 66. The informal group asks GRSG to decide if the scope of the Regulation should include all class B (M2 and M3) vehicles or only those exceeding 16 passengers.

For double-deck vehicles of category M3, class II, III or B, the majority of the experts propose to extend the scope of UNECE Regulation No. 66 and to apply the Regulation on an optional basis for double-deck vehicles. The informal group asks GRSG to amend the text of the regulation on basis of the informal group's recommendation. In addition, research is needed on the influence of belted passengers if double-deck vehicles are subject to rollover.

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