

REGULATION No.107  
(M2 and M3 vehicles)

**Proposal for amendments concerning emergency windows**

**INTRODUCTION**

From the provisions in paragraph 7.6. of Annex 3 to UNECE Regulation No 107 (Exits) <sup>1</sup>, it can be deduced that a single-decker belonging to category M<sub>3</sub> class III having a 60 passenger seat arrangement plus one crew member has to be fitted with seven exits <sup>2</sup>. As one service door and one emergency door is provided and insofar as two hatches have to be fitted <sup>3</sup> but counted as one, five emergency windows would legally be required to be fitted.

Emergency windows which are not considered as "ejectable" have to be made up exclusively of "readily breakable safety glass" <sup>4</sup>. In accordance with the state-of-the-art, side windows are bonded to their surrounding frame and cannot be deemed to be "ejectable". Consequently, the use of laminated glazing for emergency side windows is not permitted in coaches and they must be made of tempered glazing.

Laminated glazing shows potential benefits in terms of road safety because of its ability to keep passengers inside the vehicle in the event of a rollover accident, in particular when passengers are not using their safety belt.

Substantial benefits are to be expected in terms of protection of the environment as the use of treated laminated glazing has the potential to reduce the penetration of heat inside the vehicle and hence to reduce fuel consumption when the vehicle is fitted with air conditioning.

Laminated glazing is heavier than tempered glazing due to its design. Nevertheless, the use of heavier materials would only have marginal effects on the vehicle mass insofar as the latter would increase by about 30 kg per vehicle, which is evidently negligible compared to the total vehicle mass.

**BACKGROUND**

Coaches are not that frequently involved in severe accidents, but when they occur the number of casualties is generally high due to the number of passengers travelling. Coach rollover accidents are the most severe crashes that expose passengers to high risks of injuries.

Although their frequency is not very high [1], the fatality risk in rollover accidents is higher than in other kinds of accident. It can be estimated that 30 % of the fatal and serious injuries occur during a rollover /overturning [2].

Many papers presented to the Informal Group of experts on Regulation 66 have shown that the risk of injury is dependent on whether the passengers are using their restraint system or

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1 Reference document: ECE/TRANS/WP.29/2006/26 adopted by WP.29 during the 141<sup>st</sup> session in March 2007.

2 Re: paragraph 7.6.1.4. of Annex 3 to UNECE Regulation No 107.

3 Re: paragraphs 7.6.11. and 7.6.1.4. *ibid.*

4 Re : paragraph 7.6.8.2.2. *ibid.*

not. Since many injuries sustained are caused by impacts within the interior, by passenger interactions or ejection through a window, the advantages of using proper restraint systems do not need to be demonstrated.

However, it is a fact that the use of safety belts in vehicles for which the number of casualties is statistically very low is not felt to be a high necessity by passengers, which means that the legal obligation to install and to use safety belts recently introduced in the Community law will possibly not have the expected impact on the reduction of the number of casualties in rollover accidents.

Therefore, the responsible authorities must ensure that passengers are kept in the vehicle even when they are not belted, as it is the key factor for their survival in the event of a rollover accident. This approach should be the main motivation for the decision-making process.

## **DISCUSSION**

### **1. Emergency exits**

Tourist coaches must be fitted with emergency windows the technical provisions of which are laid down in Paragraph 7.6.8. of Annex 3 to UNECE Regulation No 107.

Currently, three solutions are available to manufacturers:

- (1) either inserting windows in moveable frames which open around an axis of rotation or are made "ejectable" under certain conditions;
- (2) or installing sliding windows in a way similar to those fitted to passenger cars which can be operated manually or by means of an electric motor;
- (3) or installing fixed windows made up of a material which can be broken easily by means of a small hammer with steel edges.

### **2. Laminated glazing**

Laminated safety glazing or plastic glazing made up of polycarbonate is only allowed in scenarios (1) and (2) above, i.e. in the case of moveable frames or sliding glazing.

As a general rule, side and rear windows are made up of tempered glass.

### **3. State-of-the-art**

In the modern construction of coaches, the glazing is generally bonded to its surrounding frame. While it can be fitted by means of a rubber gasket which distorts and allows the glazing to detach if loaded sufficiently [3], this solution is not anymore favoured by the coach manufacturers.

Bonded glazing contributes to the stiffness of the construction and therefore constitutes the current state-of-the-art.

#### **4. Experience gained with windscreens**

Windscreens are made up of laminated glass. Usually they are bonded by means of polyurethane adhesive [3]. This technique shows an indubitable advantage because it prevents the ejection of passengers, besides ensuring good visibility to the driver in the event of shattering.

Preventing passengers to be ejected is one of the most significant advantages inherent in the use of laminated safety glazing in vehicles.

#### **5. Rollover accidents**

Annually, an average of 150 passengers travelling in coaches and minibuses are killed and more than 30 000 persons are injured in road accidents throughout the European Union. The vast majority of these fatalities occur because the passengers are violently thrown around within the confines of the vehicle or, even more seriously, ejected from the vehicle through the broken windows. Most of the coaches involved in an accident deviating off a road will finally overturn on to their side [2].

Keeping occupants within an overturning vehicle can be the key to their survival. Generally, most of them who are ejected will die of their injuries. Those occupants that remain in the vehicles as they come to rest will generally survive. In addition, the injury severity of the casualties is less if the vehicle is equipped with a seat restraint system and with laminated glass [4].

In this respect the advantage of using side glazing made up of laminated glass has been acknowledged by researchers to avoid total and partial ejection [5]. No researcher is defending the use of tempered glazing in particular when the rollover is part of a dynamic process including several phases [3]. Tempered glazing will break during the rollover process and passengers seated near the side windows will be dragged on the ground or pavement even if they are using their safety belt. In such event, injuries will be particularly severe.

#### **6. Increase in mass due to the use of laminated glass**

Assuming a density of 2.5 kg/dm<sup>3</sup> for the glass, a glass pane, of whatever the material, shows a mass of 2.5 kg per square meter and per mm of thickness. Therefore the move from a tempered pane to a laminated one induces an increase of mass depending only on the increase of thickness. Assuming a change from a 5.0 mm tempered glass pane to a 6.1 mm laminated plane [3], the mass would increase in a proportion of about 1 kg per square meter of glass surface, which can be assumed at  $\pm 30$  kg with respect to the side windows of a modern 12 m long single-decker.

Clearly, such mass increase should not be an obstacle in the decision-making process.

#### **7. Evacuation of passengers**

Rapid evacuation of a vehicle is seen as an important key to success in protecting lives in the event of accident and, more specifically, of fire. In a first instance one may believe that passengers would escape through the side windows by breaking the glazing.

Several publications show that this is not necessarily the scenario which is encountered in practice. Some researchers conclude that the use of emergency windows made up of “readily

breakable safety glass” is questionable in the event of fire because the time required for evacuation is too long and the opened window would cause a draught feeding the fire [5].

The Accident report drawn up by the US National Transportation Safety Board after a coach fire on Interstate 45 in September 2005 [6] concludes in the same terms.

The NTSB report stresses the fact that children, senior citizens and injury victims cannot easily deal with the problems of emergency evacuation under stress. It underlines that passengers may have difficulty figuring the method of window operation; their natural inclination is to leave by the exits they recognise, such as service doors [6].

## **8. Rescue systems**

Experience with bonded windscreens shows that the development of bonded elements, even of big surface area, is well managed. Industry has been capable of developing appropriate technologies preventing the windscreen from being ejected in the event of a roll-over accident [7].

The necessary tools exist to allow rescuers to intervene in order to cut out the windscreen. These tools exhibit the disadvantage that they can only be operated by trained rescuers [8].

The same tools would be used to open side windows in case of emergency.

## **9. Pictograms to identify the nature of the glass used**

There have been long discussions in the past in GRSG concerning the use of appropriate pictograms to identify the emergency exits without a general consensus being found. Those pictograms used in building areas to show where to find door exits are not quite appropriate for use in vehicles as their meaning could be confusing for passengers.

Recently research work made at the demand of the Rail Safety & Standards Board has identified new signs which would match the objectives of correctly informing passengers and rescuers [9].

Affixing appropriate pictograms aimed at informing rescuers that side-windows are made of laminated glazing is a key-element for quick intervention on the scene.

## **CONCLUSIONS**

It is reasonable to be expected that if Industry has the opportunity to fit side glazing made up of laminated glass which is resistant in the event of a roll-over accident, substantial benefits would result in terms of road safety.

Given that the current legislation does not allow laminated glazing, industry has no incentive to develop new innovative technical solutions. This situation has to be reviewed.

It is proposed:

- to allow the fitting of bonded laminated glazing for side-windows in a first step;
- to mandate the fitting of bonded laminated side-windows from a date to be defined;
- to use appropriate pictograms on emergency windows to better identify which kind of glazing is used.

These provisions should apply to category M<sub>3</sub> Class III vehicles, single- and double-deckers belonging to new and existing types in accordance with a transitional time period. Only side-windows would be concerned.

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### References

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