

## FACTS, THOUGHTS FOR CONSIDERATION

### 1. Evacuation of buses

In case of emergency (accident) the passengers have to be able to leave the bus or in other words the bus shall be evacuated:

- as quickly as possible
- without causing further injury to the passengers by the evacuation
- assuming no skilled outside help (only the driver may be considered if not seriously injured)

After very serious accident the passengers have to be rescued from the bus by skilled persons (firemen) but this is not the case when the occupants operate and use the emergency exits.

### 2. Service door versus emergency exit

The easiest way to evacuate the bus is to use the service doors. The passengers know them, the access is well usable to the doors.

- the service doors may be used only, when the bus stands on its wheels (standing position)
- if there are at least two service doors (or one service and one emergency door), in standing position there is no need for further emergency exit in these accident situation
- if the bus is lying on its side, the service doors (emergency door) cannot be used for evacuation, only emergency exits are available.

### 3. Accident situations

The following accident situations shall be studied, when thinking about evacuation:

- a) Frontal collision
- b) Side impact
- c) Rear impact
- d) Fire without other accident (simple fire)
- e) Combined accident (fire after collision, or rollover)
- f) Rollover (tip over)

In the cases “a”, “b”, “c”, “d” and “e” (but only if the primary accident belonged to the first four cases) the bus is standing on its wheels, in case “f” and partly “e” (combined rollover) the bus is lying on its side or rarely on its roof after the accident.

#### **4. The frequency of different accident situations**

To evaluate the necessity of emergency exits, the frequency of those accident situations should be considered in which these exits are used. Based on Hungarian statistics, the following figures may be fixed:

- 4.1. *Side impact (both sides) and rear impact* together, in which bus occupants were injured: 2,5 accidents/year as an average of 8 years observation
- 4.2. *Simple bus fire*: 12 fires/year in 8 years observation (30 years old Hungarian statistics showed 8-10 times higher figure), 80-85% of these fires happened in city operation. In 92-95% of all fires the driver stopped the bus, opened the service doors. In the remaining 5-8% the passengers have to operate the doors in emergency situation (manual operation)
- 4.3. *Frontal collision* 26 accidents/year as an average of 8 years observation, considering those frontal collisions in which bus occupants were injured. One third of these accidents happened to small buses, 2/3 to large buses, 60% of the large buses collided with small vehicles (cars, vans), in these cases only a few slight injuries occurred and the passengers could leave the bus through the service doors. Around 25% of all bus frontal collisions (6,5 accidents/year) are due to heavy vehicles or stable objects.
- 4.4. *Rollover*: in spite of the public opinion, the bus rollover is not a rare accident, 14 rollovers/year as an average in 10 years observation.
- 4.5. *Combined accidents*: very rare, but very severe accident type, less than 0,5 accident/year during 8 years observation.

Studying the world wide accident information and different statistics, there are no basic deviation, divergence from the Hungarian experiences.

#### **5. Emergency exits used in different accident situations**

Analysing the possible ways of evacuation in different post accident situations, considering the available information, the following may be said:

##### *5.1. Side and rear impact*

- a. The structural damage of the bus body – if any – is local, therefore one service door (or emergency door) remains operational and that is enough to evacuate the bus
- b. There is no need for other emergency exits
- c. In the case of small buses the rear wall door substitutes the second door and the driver's cab door can be also considered.

##### *5.2. Simple bus fire*

- If the fire was recognized in the early stage (after initiation, during the slow propagation period) which is the 92-95% of all fires, the bus can be evacuated through a driver operated service door very quickly, without panic and without injury
- If one service door cannot be used, because the fire is initiated close to the door, the other door(s) can be used
- There is no need for other emergency exits.

### 5.3. *Frontal collision*

It is a very inhomogeneous accident type in respect of the evacuation.

- In the “low energy” frontal collisions (with small vehicles, with low speed) the service doors may be used for evacuation
- In a “high energy” collision the front service door can be damaged, unserviceable. But the second door (service or emergency) remains serviceable.
- there is no need for other emergency exits

### 5.4. *Rollover*

- In the past accident position the bus does not stand on its wheels, the service doors cannot be used for evacuation.
- Other emergency exits, like escape hatches, rearwall window, windscreen have more importance
- In every rollover accident there is a need to use emergency exits other than service doors
- The side emergency windows have no importance, they are unusable when the bus is lying on them, or when the passengers have to break them above the head and climb up to use them.

### 5.5. *Combined accidents*

- Fire after frontal collision is a more severe version of the frontal collision. It should be considered that the fire could block the use of one door
- Fire after rollover is a more severe version of the rollover. It should be considered that the fire could block the use of emergency exits in certain part of the bus.

## 6. **Conclusions**

- Evacuation of the bus based on the occupants activity differs from the situation, when the passenger are rescued by outside skilled help (e.g. firemen)
- When the bus is in standing position in the past accident situation, the most important emergency exits are the service (or emergency) doors. Other emergency exits practically are not needed and not good for use
- After a rollover accident the doors are practically unusable, only other emergency exits, like escape hatches, rearwall window, windscreen can be used. In every rollover accident there is a need for emergency exits
- The emergency side windows practically have no (or very low level) importance in any past accident situations, so when discussing the use of laminated safety glass versus breakable glass for side windows, the advantage of the laminated glass (avoiding the ejection) shall be emphasized
- The frequency of the accident situations in which the bus has to be evacuated for safety reason are rather different, the simple fire and the rollover seems to be the most frequent. In the fire the service doors are the most important exits for evacuation, in rollover the other emergency exits

- There is no need to increase the required number of usable emergency exits (specified in R.107 Annex 3, para.7,6,1,4) or may be it can be reduced, but in every past accident situation the same requirement shall be met.
- The usability of different emergency exits in different past accident positions shall be specified on technical basis.

## **7. Proposal**

If the group accepts this approach, Hungary is ready to prepare a draft proposal to the modification of the text of R107.

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