

EMERGENCY EXITS OF BUSES, ARGUMENTS AND PROPOSAL

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CONTENT

1. Arguments, explanations, examples

- Definitions
- Principles
- Examples, observations, experiences

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DEFINITIONS

The ways of leaving the bus in a post-accident situation:

Evacuation: unaided action, mainly through the doors. (handicapped, elderly, injured people are helped by the driver or other passengers) Generally the bus is standing on its wheels.

Escape: in unusual situation, mainly through emergency exits with not organized, skilled outside help. The driver is key person in this situation, too.

Rescue: the occupants are taken out by skilled, outside help (firemen), after a severe accident.

Only the first two cases are considered

DEFINITION

Requirements of emergency exits (EE) in UN-ECE Regulation R.107 (General safety provisions of buses):

- **Required number of EE-s and their location**
- Required minimum dimensions of different EE-s
- Configuration and dimensions of the access to EE-s, inside the bus
- Technical requirements of EE's operation
- Marking, instruction to the passengers

Only the first issue is considered and discussed here

DEFINITIONS

Types of EE-s to be considered:

- service door
- emergency door
- driver's door (on the driver's cab)
- escape hatch (on the roof or on the floor)
- emergency side window
- emergency rear window
- windscreen (possibility in the future)

DEFINITIONS

Past-accident situations, bus-positions to be considered:

- frontal collision (full and partial, too)
 - side impact (both sides; only with heavy vehicles)
 - rear impact (with heavy vehicles)
 - simple fire (different fire location to be considered)
 - combined accident
 - fire after collision
 - fire after rollover
 - rollover
 - special accidents
-
- a)
- b)

a) the bus is standing on its wheels

b) the bus could be in different positions

DEFINITIONS

The rollover can produce all the main past-accident positions



lying on the side



on the wheels after one rotation



standing on the roof

DEFINITIONS

It is interesting to have information about **the frequency of different accidents**; when evaluating the usability of different EE-s

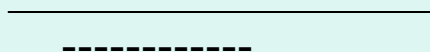
Type of accident	Accident/year
Rear and side impacts together	2,5
Simple fire	12,0
Frontal collision (all bus categories)	26,0
large buses only	17,0
large buses with heavy vehicles and stable objects	4,0
Rollover (all bus categories)	14,0
Large buses only	8,5
Combined and special accidents	0,5

- collected in the years 2002-2010
- in Hungary (population 10 millions, 93.000 km², average bus fleet 18.000)
- all bus categories were considered
- accidents, in which at least one bus occupant was injured (except the fires)

PRINCIPLES

Assumptions and stipulations when determining the required number of emergency exits and their location

In the existing R.107 Annex 3. para. 7.6



There is no time limitation in the evacuation of the bus

The bus is standing on its wheels

The usability of every EE types is the same



One EE type has the same usability in every bus category

For the new proposals

The occupants shall have the same, acceptable safety level to evacuate the bus in every basic past- accident position

The possibility of a fire shall be considered for the complete evacuation (time limit ≈ 300 s)

At least 4 basic positions shall be considered

The usability of different EE types is essentially different

The usability of different EE types strongly depends on the past- accident position of the bus

One EE type may have different usability in different bus categories

PRINCIPLES

In the existing R.107 Annex 3. para. 7.6

All EE-s are available (usable) in every past- accident position

Every considered EE is operative (usable) in a past- accident position

The requirement number of EE-s shall be proportional to the passenger capacity of the bus

The breakable emergency windows are usable EE-s

For the new proposals

Only a few EE-s are available (usable) on every past- accident position

One considered EE could be out of work (unusable) because of local problems

The requirement number of EE-s shall be proportional to the individual (crew, passenger) compartments.

The absolute minimum number of required EE-s shall be 2 in small compartments in all past- accident positions.

The breakable emergency side windows shall not be counted as required EE-s.

PRINCIPLES

In the existing R.107 Annex 3. para. 7.6

The rear wall window is allowed to use as EE

The windscreen is not a possible EE

For the new proposals

The rear wall window shall be required in every bus as EE, it is usable in most of the past accident position.

The windscreen shall be considered as a possible EE, if certain conditions are met (e.g. glass cutting electric hand machine is available for the driver)

In the case of large scale, general structural damage the EE-s do not have meaning, no possibility for evacuation.

PRINCIPLES

Instead of giving detailed technical specifications to the „usability of EE-s” the expert group should agree on the following principles:

- in spite of increasing and extending the safety level of occupants to evacuate the bus in all major past- accident situations, the required number of emergency exits should be reduced and the sitting requirements simplified in the existing R.107
- there is no general, large - scale structural deformation on the superstructure in the past- accident position, so the exits are functioning, but one emergency exit may be blocked (by local deformation, fire, etc.)
- when the bus is standing on its wheels (or on its roof) the service and emergency doors are enough to evacuate the bus (this was proved by tests and by real accidents). The best emergency exits are the doors: first the service doors, after that the emergency doors.
- when the bus is lying on its side, the usable emergency exits are the rear wall emergency window and the escape hatches (and – possible, but not required – option could be the windscreen)
- the lower deck of a double deck vehicle may have escape hatches on the floor (low floor, nothing below it), this is allowed in the existing text as well

PRINCIPLES

- The breakable side wall emergency windows are unusable and useless in all past-accident situations (it was proved by tests and by real accidents), therefore they are not required and counted among the minimum number of emergency exits, but side windows could be allowed if certain technical requirements are met, as extra emergency exits to provide extra safety
- the (emergency) exit requirements in relation to their minimum number and location (sitting) shall relate to the individual occupant – passenger and driver – compartments, rather than to the complete vehicle (Of course , many times there is only one compartment in the bus, in this case the two approaches coincide)
- in the practice, separate passenger compartment, the capacity of which exceeds 100 passengers does not exist
- the required minimum number of emergency exits shall relate to the number of occupants in the compartments (passenger, driver, crew compartment)
- the airport buses – operating inside the airports – and the rail guided special buses are not covered by regulation R.107.

EXAMPLES, OBSERVATIONS, EXPERIENCES

The EE-s are usable only, if no large scale general structural deformations



EXAMPLES, OBSERVATIONS, EXPERIENCES

Certain EE-s may be blocked in the past-accident position



EXAMPLES, OBSERVATIONS, EXPERIENCES

Side windows in different bus categories



Unusable in traditional and high deck coaches
(outside ladder and help is needed)



Unusable on the upper deck
May be usable on the lower deck of a double deck bus
or in low floor bus

EXAMPLES, OBSERVATIONS, EXPERIENCES

Breaking glass test on side window



- 30 years old women, using protection gloves and face protective mask
- finding and getting the hammer 15 s
 - creating a „fire exit” with appropriate size, additional 25 s
 - Leaving the bus with massive outside help, additional 50 s
- altogether 90 s

Unusable way for evacuation!

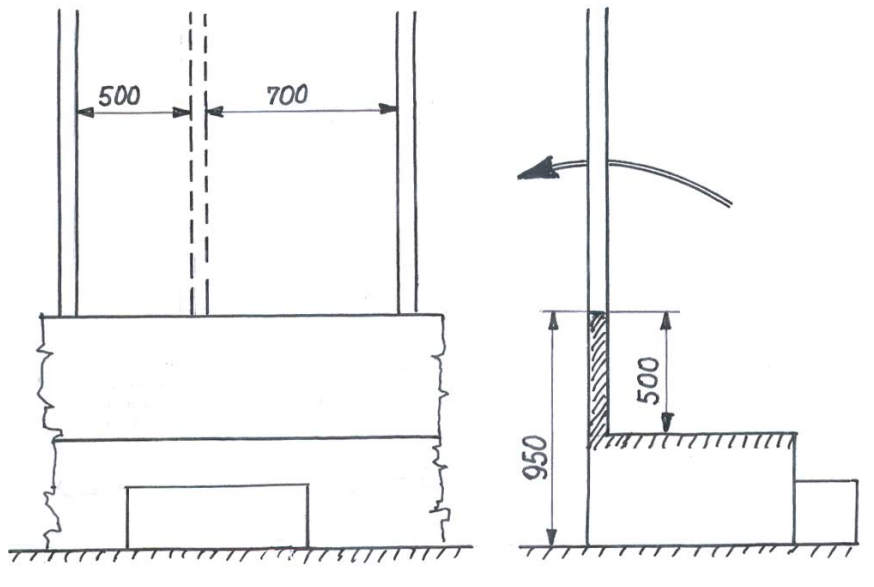
EXAMPLES, OBSERVATIONS, EXPERIENCES

Evacuation test was carried out by Cranfield Inst. of Technology (U.K.)

Simulation of the use of side emergency window, when the bus is in standing position

- 100 voluntary elderly people (average age 73 years)
- they knew what to do
- no glass breaking, no sharp glass fragments

- **44% refused to pass the test**, they were unable to exit through this window simulation



In the reality:

inside height 500 mm → 700-800 mm

outside height 950 mm → 1600-1800 mm

EXAMPLES, OBSERVATIONS, EXPERIENCES

The usability of service and emergency doors



usable, when the bus is standing on its wheels, or on the roof



unusable when the bus is lying on its side



EXAMPLES, OBSERVATIONS, EXPERIENCES

The usability of escape hatches in different past-accident positions



Unusable when standing on the wheels

... or on the roof

Usable in lying position

EXAMPLES, OBSERVATIONS, EXPERIENCES

The rear window and rear door



is **usable** in **both lying** positions and when the bus is **standing on its roof**

EXAMPLES, OBSERVATIONS, EXPERIENCES

The windscreen is a possible well usable and very often used EE in all past- accident positions



EXAMPLES, OBSERVATIONS, EXPERIENCES

The small buses need special consideration



PROPOSALS

- Modifications in the existing text of R.107 Annex 3. paragraph 7,6
and Annex 7
- Paragraphs, remaining unchanged are not mentioned here, only the proposed changes are shown
- Words with bold letters are new, additional parts, the crossing out means proposed deletion

PROPOSALS

In Annex 3

7.6 Exits

7.6.1. Number of exits

7.6.1.1. The minimum number of doors in a vehicle **compartment** shall be two, either two service doors or one service door and one emergency door. Every double-deck vehicle shall have two doors on the lower deck (see also paragraph 7.6.2.2.). **The intercommunication staircase shall be considered as a service door of the upper deck.** The minimum number of service doors required is as follows:

Number of passengers and crew to be accommodated in each compartment	Minimum number of service doors		
	CLASS I & A	CLASS II	CLASS III & B
9 - 45	1	1	1
46 - 70	2	1	1
> 71 - 100	3 (2 in the case of a double-deck vehicle)	2	1
> 100	[4]	[3]	[1]

7.6.1.2. The minimum number of service doors in each **separate compartment and** each rigid section of an articulated vehicle shall be one except that this minimum number shall be two in the case of front section of an articulated vehicle of Class I.

PROPOSALS

7.6.1.4. The minimum number of emergency exits shall be such that the total number of exits in a separate compartment is as follows:

Number of passengers and crew to be accommodated in each compartment	Minimum total number of exits
1 - 8	2
9 - 16	3
17 - 30	4
31 - 45	5
46 - 60	6
61 - 75	7
76 - 90	8
91 - 110	9
111 - 130	10
>130	11

The number of ~~exits~~ **doors** for each separate deck (in the case of a double-deck vehicle) and each separate compartment must be determined separately. Toilet compartments or galleys are not considered to be separate compartments for the purposes of defining the number of emergency exits. Escape hatches can only count as one of the above-mentioned number of emergency exits.

PROPOSALS

7.6.1.5. Each rigid section of an articulated vehicle shall be treated as a separate vehicle **compartment** for the purpose of determining the minimum number and the position of ~~exits.~~ **doors**. The connecting passage between them shall not be considered as an exit. **door**. ~~Toilet compartments or galleys are not considered to be separate compartments for the purposes of defining the number of emergency exits.~~ The number of passengers shall be determined for each rigid section. The plane, which contains the horizontal axis of the hinge between conjoined rigid sections of the vehicle, and perpendicular to the longitudinal axis of a vehicle, when it moves straight, shall be considered as the border between sections.

7.6.1.6. A double service door shall count as two **service** doors, and ~~a double or multiple window as two emergency windows.~~ **but only as one emergency door.**

PROPOSALS

Introduce the following new paragraphs:

- 7.6.1.7 All vehicles of Class II, Class III and B shall have emergency exit on the rear wall (either a door or emergency window).**
- 7.6.1.8. Not breakable side wall emergency windows may be provided in every vehicle categories and Classes, but they shall not be counted in the minimum required number.**
- 7.6.1.9. The windscreen of the upper deck of a double-deck vehicle may be considered as a an emergency door, or one escape hatch, if it meets the technical requirements of an emergency window.**
- 7.6.1.10. The windscreen of a vehicle may be considered as an emergency door or escape or escape hatch, if the vehicle is equipped with an electric glass cutting hand tool, located in the driver compartment.**

Renumber the existing paragraphs behind these new insertion

PROPOSALS

7.6.1.7.2. Change in the fourth subparagraph:

The door provided for the passengers **additional people** shall be in the side of the vehicle opposite to that containing the driver's door and shall be accepted as the emergency door for the driver.

7.6.1.11. Escape hatches, additional to the emergency doors and windows, shall be fitted in the **compartments of** vehicles of Class II, III and B (in the upper deck roof **hatches, in the lower deck floor hatch** in the case of double-deck vehicles).

The minimum number of hatches shall be:

Number of passengers (in the upper deck in the case of double-deck vehicles) and crew in a compartment	Minimum number of hatches in Class II, Class III and B
not exceeding 50	+
exceeding 50	2
- [23]	1
[24] - 45	2
46 - 70	2
> 71 100	3
[> 100]	[4]

They may also be fitted in the case of Class I and A vehicles

PROPOSALS

~~7.6.1.12. Each intercommunication staircase shall be considered to be an exit from the upper deck of a double-deck vehicle.~~

Renumber the following paragraphs accordingly

7.6.1.13. All persons accommodated in the lower deck of a double-deck vehicle must in **an all kind of** emergency situations, (**e.g. when the vehicle is lying on its side**) have access to the exterior of the vehicle without having to enter the upper deck.

7.6.1.14. The upper deck gangway of a double-deck vehicle shall be connected by one or more intercommunication staircases to the access passageway of a service door or to the lower deck gangway within 3 m of a service door:

~~7.6.1.14.1. two, or at least one and one-half staircase, shall be provided in Class I and Class II vehicles if more than 50 passengers are carried on the upper deck;~~

7.6.1.14.2. Two, or at least one and one-half, staircases are to be provided in Class III vehicles if more than [30] passengers are carried on the upper deck.

PROPOSALS

7.6.2. Sitting of exits

~~Vehicles having a capacity exceeding 22 passenger seats shall meet the requirements shown below. Vehicles having a capacity not exceeding 22 passengers may meet either the requirements shown below or those contained in Annex 7, paragraph 1.2.~~

7.6.2.1.2. the provision of an additional service door in the rear face of a vehicle (**especially in Class B**) principally for loading/unloading of goods or luggage, but which could be used by passengers where circumstances so require, or

~~7.6.2.1.3. the provision of one or more additional service doors on the opposite side of the vehicles in the case of vehicles designed for use in circumstances which require loading/unloading on both sides. Examples of such circumstances include vehicles for airside use at airports, vehicles for use on multimodal transport systems using island platforms, or vehicles which cross borders to countries which do not drive on the same side of the road as the country in which the vehicle is to be licensed for operation. Vehicles so equipped shall be provided with control(s) which allow the driver to inhibit normal operation of the doors which are not currently in use, or~~

~~7.6.2.1.4. the provision of a service door in the rear face of a Class A or B vehicle.~~

PROPOSALS

- ~~7.6.2.3. The exits (on each deck in the case of a double-deck vehicle) shall be placed in such a way that their number on each of the two sides of the vehicle is substantially the same. (This shall not imply the need to provide additional exits over and above the number specified in paragraph 7.6.1.). **The emergency door shall be placed on the other lateral wall as the service door(s)**~~
- ~~7.6.2.4. At least one exit shall be situated either in the rear face or in the front face of the vehicle respectively. For Class I vehicles and for vehicles with a rear part permanently closed off from the passenger compartment, this provision is fulfilled if an escape hatch is fitted. For double-deck vehicles, this requirement shall apply only to the upper deck.~~
- ~~7.6.2.5. The exits on the same side of the vehicle shall be suitably spaced out along the length of the vehicle.~~
- ~~7.6.2.6. A door shall, provided that it is not a service door, be permitted in the rear face of the vehicle.~~
- ~~7.6.2.7.4. If Escape hatches are fitted, they shall be positioned as follows: if there is only one hatch, it shall be situated in the middle third of the passenger compartment, if there are two **or more** hatches, they shall be separated by a distance of at least 2 m measured between the nearest edges of the apertures in a line parallel to the longitudinal axis of the vehicle.~~

PROPOSALS

Annex 7

ALTERNATIVE REQUIREMENTS FOR VEHICLES OF CLASSES A AND B

1. Vehicles of Classes A and B shall comply with the requirements of Annex 3 with the exception that:

(a) in place of paragraph 7.6.3.1. of Annex 3, a vehicle may comply with paragraph 1.1. of this annex;

~~(b) in place of paragraph 7.6.2. of Annex 3, a vehicle may comply with paragraph 1.2. of this annex.~~

~~1.2. Sitting of exits~~

~~1.2.1. The service door(s) shall be situated on the side of the vehicle that is nearer to the side of the road corresponding to the direction of the traffic in the country in which the vehicle is to be registered, or in the rear face of the vehicle.~~

~~1.2.2. The exits shall be placed in such a way that there is at least one exit on each side of the vehicle.~~

~~1.2.3. The forward half and the rearward half of the passenger space shall each contain at least one exit.~~

~~1.2.4. At least one exit shall be situated either in the rear face or in the front face of the vehicle unless an escape hatch is fitted.~~