USABILITY OF EMERGENCY EXITS (EE)

1. Basic documents:

   [1] New requirements to the emergency exits of buses. Written paper, Presented in Warsaw, January, 2009.

   [2] New requirements to emergency exits of buses. Power point presentation, Warsaw, January, 2009.

2. After a discussion of experts in Hungary, an improved version of "Usability" is proposed: four levels, instead of six (proposed in the basic documents)

   - good
   - acceptable
   - weak
   - unusable

3. Table 1. in [1] shall be modified accordingly. This table gives the technical specifications of "usability".

Usability Technical aspect	Good	Acceptable	Weak	Unusable
Opening (1)	simple, easy, no effort from passenger	simple, small knowledge and effort from passenger	considerable effort and skill is needed from passenger	In the given situation it is put out of action(3)
Climbing up to the exit when use it	no need	less than [1 m]	more than [1 m]	
Jumping down from the exit when use it	less than [1 m]	less than[1,8 m]	more than [1,8 m]	
Possibility of continues use (2)	possible with small help	possible with inside help	possible with inside and outside help	

(1) opening includes: to find the exit, to understand its operation and to open it
(2) considering children, elderly passengers and injured persons, too, following each other in the evacuation
(3) e.g. when the bus is laying on that side where the exit is located

4. The following possibilities shall be considered as possible EE. (These are different types of EEs)

   SD service door
   ED emergency door
   RD rear-wall door
   DD driver's cab door
   SW side-wall window
   RW rear-wall window
   WS windscreen

EH escape hatch

5. The following (after)accident situations shall be considered when determining the required number and location of EEs:
   - rollover, considering the possible four major (after)accident situations (until one complete rotation)
   - front impact, considering the total or partial impacts, too.
   - side impacts with heavy vehicles, possibly on both sides
   - rear impact, when heavy vehicle runs into the bus
   - fire in the bus, considering different locations of fire.
   - bus in shallow water (not completely sunk)
   - combined accidents (possible combination of the above said accidents)
   - special accidents
6. The following statements shall be considered when determining the required number and location of EEs. The usability of:
   - the same type of EE could be different in different (after)accident situations
   - the same type of EE could be different in different bus categories
   - one given EE could be different in different accident situations
   - different types of EEs are not equal in different (after)accident situations
7. Basic document [1] shows the evaluations of different EEs in four essential (after) accident situations (the bus is standing on its wheels, lying on its both sides and standing on its roof) Table 5-8 shall be modified accordingly to the new, four levels usability specifications. As example, the revised Table 5. is shown below (The bus is standing on its wheels)

Evacuation through	Large, single deck bus		Double deck bus		Small bus
	Low deck	High deck	Lower deck	Upper deck	
SD	good	good	good	-	good
ED	good	good	-	good	-
RD	-	-	-	-	good
SW	good	acceptable	good	weak	good
RW	acceptable	weak	-	weak	unusable
EH	weak	weak	-	week	acceptable
DD	weak	weak	weak	-	weak
WS	acceptable	acceptable	acceptable	weak	-

8. The proposed requirements for the minimum number and location of EEs is modified accordingly below:

a) every separated passenger compartment in every essential bus position (standing on its wheel or on its roof, lying on its sides = 4 positions) shall have:
   - up to 20 passengers min. 2 at least “acceptable” EE-s, among which at least 1 is “good” .
   - for 21-70 passengers min. 6, at least “acceptable” EE-s, among which min. 2 is “good”
   - above 70 passengers, additionally two at least “acceptable” EE-s are required

b) above the required number of “good” EE-s, every extra “good” one shall be considered as two “acceptable” EE-s.

c) the staircase to the upper deck in DD vehicles or the joint section between the two parts of articulated vehicles may be connected as a “good” EE when the vehicle is standing on its wheels.

9. As an example, let us check a 12 m long tourist coach with 53 passenger capacity and waistrail height above the road 1,7 m and above the seat-floor 0,8 m. The coach has the following EE-s: 2 service doors; 1 emergency door; 3 escape hatches; 1 rear-wall emergency window; 2-2 side-wall emergency windows and 1 one windscreen.

   The required number of EE-s is: minimum 6 “acceptable” EE-s among which at least 2 are “good” or “very good” in every essential bus position.

EE-s	Standing on the		Lying on the	
	wheels	roof	door side	other side
2 SD	good	good	-	-
1 ED	good	good	-	-
4 SW	acceptable	good	-	-
1 RW	acceptable	good	good	good
3 EH	-	-	good	good
1 WS	acceptable	good	good	acceptable*
good or very good	3	9	5	4
acceptable	6	2	-	1
requirements	met	met	met	met

* the driver’s cab should be considered as possible obstacle

10. It has to be underlined that in the future:
    - the importance of the rear wall emergency window shall be increased
    - the windscreen shall be involved into the emergency exits, one of the best possibility
    - the importance of the side wall emergency exits shall be reconsidered (decreasing importance)

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