

NECESSITY AND USABILITY OF BREAKABLE EMERGENCY SIDE WINDOWS ON BUSES

(Explanation to informal document GRSG-103-03)

103rd GRSG meeting
Geneva, October, 2012

Presented by
Dr. MATOLCSY, Mátyás
Hungarian delegate

SIDE WINDOWS – LAMINATED GLAZING

There are 4 basic past-accident situations, when the bus has to be evacuated as quick as possible:

1. The bus is standing on its wheels
2. - 3 The bus is lying on its side (left or right)
4. The bus is standing on its roof

The following exits may be considered as emergency exit:

- service doors
- emergency door
- rear window
- side windows
- escape hatches
- windscreen

SIDE WINDOWS – NECESSARY?



SIDE WINDOWS – NECESSARY?

When the bus is standing on its wheels

- Generally there are at least two service doors and one emergency door on the other side
- If one of them is damaged in consequence of the accident, remain two doors
- One door as emergency exit is enough to evacuate the bus in time. It was proved by evacuation tests.
- **There is no need for emergency side windows!**



But in extreme necessity (e.g. lower floor of a double deck bus) emergency side window may be provided other than breakable one (hinged type, kick out type, etc.)

SIDE WINDOWS – NECESSARY?

If necessary: solution used on the bus of Boston Transport



After opening a fastener by lifting a bar, the whole window can be pushed out, it falls down and the whole window aperture can be used as emergency exit.

SIDE WINDOWS – NECESSARY?

When the bus is lying on its side

- Usable emergency exits are the rear window and the escape hatches and also the windscreen
- Side windows on one side are blocked by the ground
- To break the glass above the head and climb up, through the window is impossible
- **There is no need for emergency side windows!**



SIDE WINDOWS – NECESSARY?

When the bus is standing on its roof

- The doors (both service and emergency) can be used to evacuate the bus quickly
- The rear window and the windscreen are also usable emergency exits
- There is no need for emergency side windows



SIDE WINDOWS - WINDSCREEN



LAMINATED GLASING - WINDSCREEN

4. There is available technology to cut laminated glassing:

- It should be an obligatory tool placed in the driver's compartment, like the fire extinguisher
- It could be used to open laminated windows, windscreens, too, for emergency exit

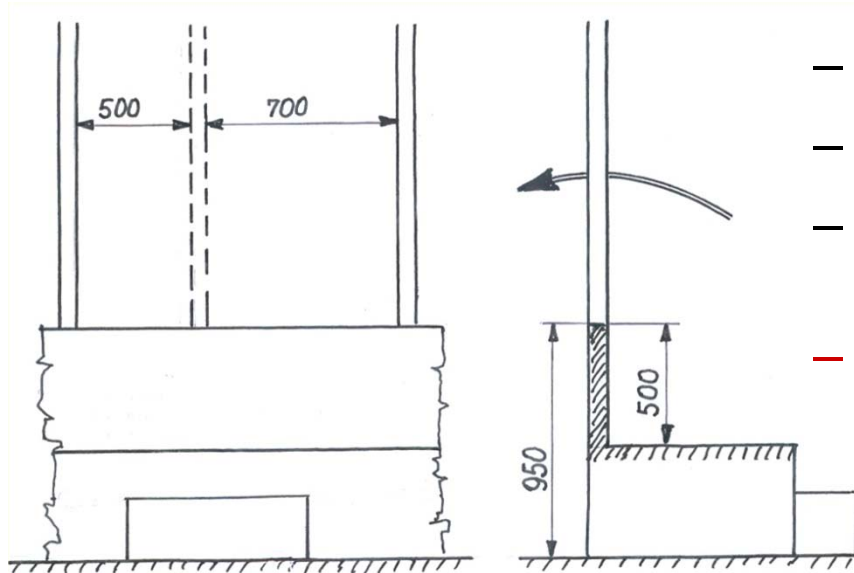
Technical Data	
Stroke length	1 in. / 25 mm
Strokes per min.	0 – 2000
Performance of battery	18 Volts, 2 Ah
Dimensions: l x w x h	18 x 9 x 4 in. / 460 x 220 x 97 mm
Weight	9 lbs / 4 kg



Rescue saw

EVACUATION TESTS

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



- 100 voluntary elderly people (average 73 years)
- they knew what to do
- empty window frame, no glass, no sharp glass fragments
- **44% refused to pass the test**, they were unable to exit through this window simulation

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

In the reality:

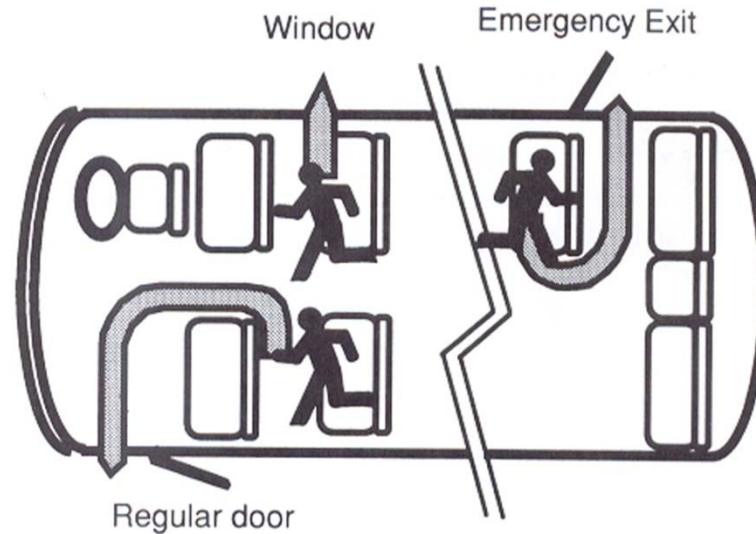
inside height 500 mm → 700-800 mm

outside height 950 mm → 1600-1800 mm

EVACUATION TESTS



Test in Japan (JAMA)



- HD coach
- service door, emergency door, side window (sliding type) was tested
- outside podiums were used in the last two cases
- three passenger groups: GR1 (8-12 y); GR2 (20-22 y); GR3 (66-73 y)
- three tests were made with every person
- measured evacuation time for individuals from starting the process (standing up from the seat) to the end (leaving the bus)

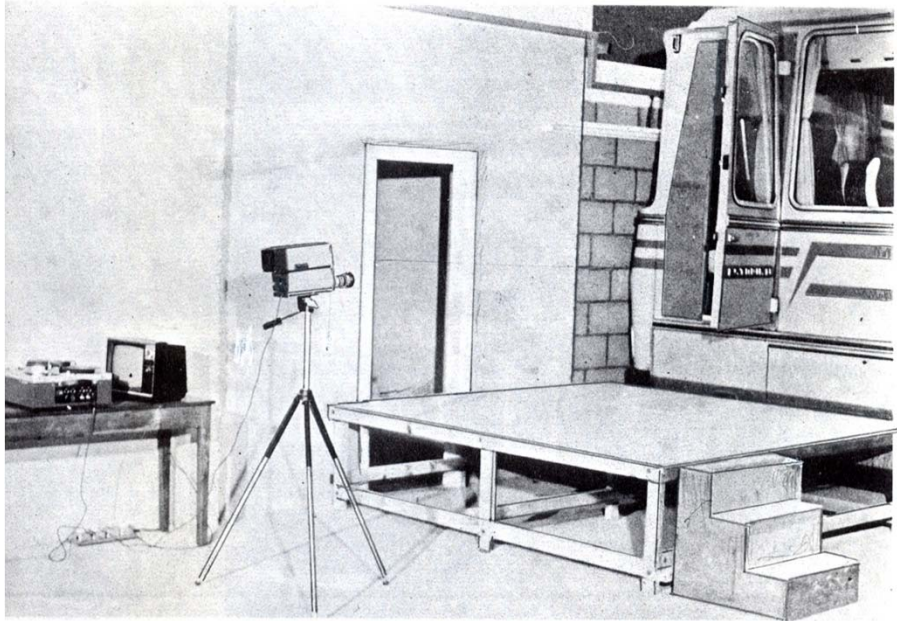
EVACUATION TESTS

Some results:

- evacuation time through service door: 7 sec/person for GR1 and GR2
10 sec/person for GR3
- through emergency door or side window: 10 sec/person, no considerable difference between groups and exits
- $\frac{3}{4}$ of the evacuation time was needed to find and get EE, to understand its operation and open it
- At the first trial no one of GR1 and only half of GR3 could perform the test with emergency door. They could not open it.

EVACUATION TESTS

Test made by Univ. of Technology, Loughborough, UK



Test with outside podiums

48 persons in every passenger group (50% male/female)

The complete evacuation time was measured (empty bus)

EVACUATION TESTS



Test without outside podium

Different passenger motions with or without podium

EVACUATION TESTS

Measured evacuation times

Way of evacuation	Group 1	Group 2	Group 3
Emergency door with podium	120 sec	150 sec	240 sec
Emergency door without podium	210 sec	210 sec	*
Emergency window with podium	270 sec	330 sec	600 sec
Emergency window without podium	**	540 sec	**

* not all the passengers could make the test

** Group 1 and 3 could not perform this test

Some interesting ratios:

Male/female 1: (1,2 – 1,5)

12 faster/12 slower passengers 1: (1,2 -1,6)

Emergency door/side window 1: (2,2 – 3,5)

EVACUATION TESTS

Hungarian tests with breakable side windows



30 years old woman, using protection gloves and face protective mask

- finding and getting the hammer 15 s
 - creating an „emergency exit” with appropriate size, additional 25 s
 - Leaving the bus with massive outside help, additional 50 s
- altogether 90 s

Unusable way for evacuation!

MAIN CONCLUSIONS

- There is no essential need for the emergency side windows
- It is not too easy to use the emergency side windows
- The breakable side windows are unusable for the passengers