

Madrid meeting
WD.6.

PERSONS AND SYSTEMS TO BE PROTECTED

(Frontal collision of buses)

Presented by Hungary

GENERAL REMARKS

When working on international safety regulations, the following issues shall be studied, cleared and solved:

1. who (what) is to be protected by the regulation
2. in which accident situation shall be protected (specification of the „standard accident”, the most severe but acceptable accident)
3. how to protect (the persons or systems), determining requirements

The protection of the bus occupants generally means the following for each individual person:

- a. to provide a survival space
- b. to keep the person in the survival space
- c. to avoid any dangerous direct load (biomechanical loads) on the person
- d. to ensure the person to leave the survival space (the bus) after the accident. This is very important particularly for the driver.

PROTECTION OF THE BUS OCCUPANTS

1. Passengers

Different casualty risk for standing and seated passengers. Extra casualty risk for passengers sitting behind partitions, behind staircase and in the first row of seats (direct deformation zone) Different casualty risk for passengers sitting on rearward and inward facing seats.

The main goals to protect the passengers:

1. to reduce and limit the deceleration of the bus in the collisions
2. to retain the passengers in the survival space, to avoid ejection (suitable seats, seat strength, safety belts, partitions, etc.)
3. to keep the deformation zone off the first row of seats,
4. to avoid the severe collisions of the passengers with inside structural parts and elements (e.g. partition, wall of DC, horizontal and vertical handholds, staircases, dashboard, etc.) giving special attention to the standing passengers.

2. Drivers

The driver is a key person in and after an accident:

1. he can control the further motion of the bus after the (first) impact to avoid more severe situations,
2. he knows how to open the doors, emergency exits, how to evacuate the bus,
3. he is the only drilled and trained person who can use the fire-extinguisher, who can estimate the severity of the situation, can ask for outside help,
4. he can help to the passengers in evacuation or give first aid

The driver has extra high casualty risk sitting directly in the deformation zone and endangered by ejection, too. To ensure the survival space for the driver is a special, important task, like to ensure him the easy leaving of the DC after the collision.

3. Crew

The crew means: tourist guide, second driver, stewardess, if any is on board. The crew is engaged only on tourist and long-distance coaches.

The special crew seat(s) generally are located in the front part of the bus, some examples are shown below:

1. next to the driver seat, one or two fixed crew seat(s) anchored to the floor, similarly to the driver seat. In this case the front service door is behind these seats
2. the folding crew seat is located in the staircase of the front service door, anchored to the front wall
3. the folding crew seat is located in the staircase of the front service door, anchored to the partition behind the staircase.⁸



The crew has extra casualty risk, while:

1. the special crew seats are directly in the main deformation zone,
2. ejection possibility through the windscreen,
3. no strength requirement for special crew seats,
4. the crew seat – after structural deformation and damage – may block the evacuation through the front service door.

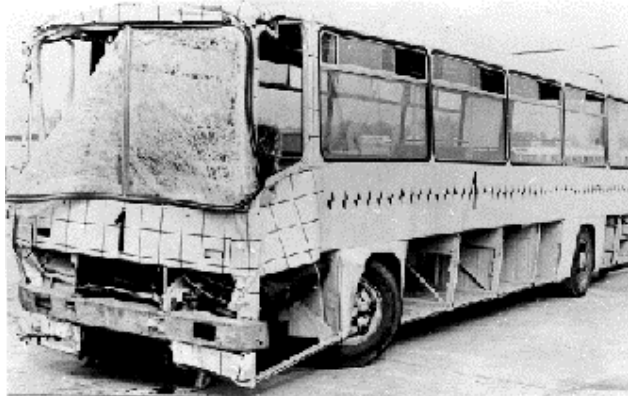
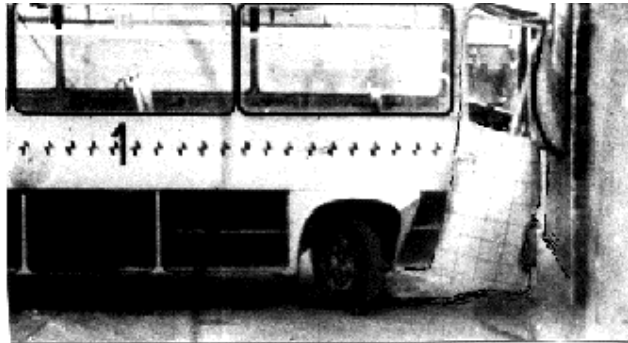
Question could be the sleeping cab (under the floor) of the second driver if it is used during traveling.

PROTECTION OF THE MAIN CONTROL SYSTEMS

Some control systems of the bus – having vital importance – are located in or under the DC, like:

1. steering system (steering column, angle drive, steering gear, rocker arm, pushing roads, hydraulic piping, etc.)
2. brake system (brake pedal, main valve, air reservoirs, piping, etc.)
3. electric system (central electric panel, fuse panel, central electronic units, electric wires, etc.)
4. engine control system (gas pedal, electronic unit, etc.)

Relative small collision – damaging one or more control systems – can result very tragic secondary accident. (No brake, the bus may not be stopped, blocked steering or unexpected self steering and the bus runs away in wrong direction, electric short circuit and the whole bus burns out, etc.) The possibility of an unexpected self-steering was proved in a frontal collision test, see below.



PROTECTION OF THE TRAFFIC PARTNERS

1. Pedestrians

Overrunning pedestrians, the shape, hardness of the front wall should be considered. Sharp edges, protruding parts, uncovered windscreen wipers, bull bars, rear view mirrors in low position, etc. should be avoided.



2. Protection of cars and small vans
That means mainly underrun protection and reducing the bus aggressivity (special bumper design and bumper position)
3. Protection of cyclists and motorcyclists
Similar problem to the pedestrian overrun, but the impact could have much higher energy level.

SUMMARY

The Table below summarizes the protected items and the belonging dangerous accident situations. The numbering of the dangerous accident types relates to the numbering used in WD.3.

Protection of	Dangerous accident type		Remarks
	main	secondary	
Passengers generally	1.1, 3B	1.2, 1.3, 2.1	Main goal is to reduce and limit the deceleration of the bus and keep the passenger in its survival space
Passengers in first seat row	1.1, 1.2, 1.3	1.4, 1.5	As above, and reduce the extension of the deformation zone, avoid the ejection of passengers
Driver	1.2, 1.4, 2.1, 2.2, 3C, 4	1.1, 3B, 2.1	Main goal: ensure the integrity of DC, avoid ejection of the driver,
Crew	1.1, 1.3, 1.5, 3A	2.1, 2.3, 4	Only in tourist coaches, main goals: ensure the integrity of the front wall, the strength of the crew seat, avoid ejection
Control systems	4	1.2, 1.4, 2.2	Main goal: ensure the structural integrity, avoid car (and small van) underrun
Pedestrians			Consider the shape, construction of the front wall and bumper
Cyclists, motorcyclist			Like in case of pedestrians
Cars, small vans			Avoid underrun, reduce aggressivity, increase compatibility (safety bumper)