

## **REPORT OF THE IG/R.66 MEETING**

Held in Prague, 12-13 June, 2007

1. The expert group IG/R.66 was invited by the Czech Republic to hold its 4<sup>th</sup> meeting in Prague, in the Ministry of Transport. The group was welcomed by Mr. Vykydal, deputy minister of the Ministry of Transport. The list of participants (25 experts from 9 countries) is given in Annex 1.
2. The final agenda of the meeting was agreed at the scene, the discussions were arranged in 6 subject groups (see Annex 2). The new working documents are shown in Annex 3, together with the former ones. These documents were distributed among the participants of IG/R.66. The main ideas and results of the presentations and discussions are listed very briefly below.

### **3. General information, statistical data**

In this subject group the experts continued to collect accident statistics focusing on the rollover and also about the operating bus fleets in different countries, about the number of buses belonging to different categories.

- 3.1. Belgian, Dutch, Italian and Spanish experts presented data about their national bus fleet, bus categories, yearly new bus registrations and also about some accident statistics. The Czech and Spanish expert promised some further information on the next meeting.
- 3.2. The French expert compared the large, single deck and double deck (DD) coaches in the simplest rollover accident (tip over, turn on side), 3-3 accidents were analysed and compared in his power point (PP) presentation and there were no significant differences between the two categories. The expert promised to circulate the very interesting document among the group members.
- 3.3. The UK presented results of research investigating accidents involving large vehicles, of which one group was buses and coaches. The UK has very, very few rollover accidents involving double decked vehicles, actually zero in quite a few years, so there is little justification for additional structural protection. However, a number were killed or seriously injured in minibus (9-16 seats) rollover accidents, so there may be greater justification for improvements to minibuses, although preventing ejection and seat belt wearing may need to be improved before structures. The French expert looked for the explanation of the significant differences between the French and UK statistical figures. More experts underlined that the different countries may have rather different statistical data. The UK presentation contained a lot of very useful information, on request the UK expert promised to circulate the presentation among the group members.

3.4. Annex 4. gives a summary of data being available until now about the bus fleets, bus categories and also some accident (rollover) figures from different countries. Further information would be welcomed.

3.5. The EC expert proposed to build up a commonly agreed rollover statistics:

- on the basis of the presented working documents
- considering the rollover accidents of the last 10 years
- serving as basis for the proposals of IG/R.66 to GRSG

#### **4. Information about DD and SB rollovers**

4.1. The Hungarian expert collected the available bus rollover accidents presented in 16 different sources, publications. In the 35 years period (since the '70-s until now) more than 600 bus rollover accidents became known, among which 29 happened to DD coaches and 84 to SB-s. These two categories appeared only in the last 10 years in the statistics. Evaluating their rates, he underlined that the DD coaches are overrepresented in the rollover accidents. There is no data enough for SB-s yet. Even if the majority of these rollover accident information are based on media reports which may include certain inaccuracies (related to the cause and description of the way of the accident, injuries, etc.) the bus rollover accidents themselves are facts, including the DD and SB rollovers, too.

4.2. German and UK experts stated that the different sources in this collection could have overlapping therefore this summarized statistics could be unreliable. The Hungarian expert agreed that this can not be excluded, but if so the overlapping could belong to the '70-s and '80-s figures and not to the last 15 years. He was sure that no overlapping in the data of DD coaches and SB-s had occurred.

4.3. The Hungarian expert showed a study about the usability of the existing approval tests in case of DD coaches and SB-s. Theoretically all the five approval methods (among which the manufacturer may chose) can be used for these two categories, too, but practically 3-4 methods are reasonable for both categories. This gives the possibility for the manufacturers to choose the most appropriate, cost effective method. (The "cheaper" methods are usable in both cases) The approval of these two categories would not be more expensive than the recent approvals.

4.4. The chairman asked the experts, which approval methods are used in their countries? Some information:

- The Netherlands: mainly computer simulation, but the full scale bus rollover test (basic test) was also used
- Spain: quasi-static calculation method (based on laboratory test results)
- UK: quasi-static calculation method
- Hungary: quasi-static calculation method and full scale bus rollover test (in the last 5 years about 15 approvals were made)

#### **5. Information about the activity of the Polish-American team**

The new standard being developed for Florida state (USA) covers the safety of small (paratransit) buses in case of rollover and side impact. The standard is in progress:

- The draft is ready, in both cases the residual space described in ECE R.66 is used as a criterion (It has to be remained unharmed during the test)
- Both tests are made by computer simulations based on laboratory test data as input
- The laboratory tests were developed, improved
- The simulations of the rollover test are carried out on four different models, working together with manufacturers and the authority:
  - one simulation is already finished with a simplified FEM model
  - the improved FEM model is ready for the second simulation, they are working now on its validation
  - the FEM model for the third simulation is in process
  - the fourth model has been already chosen but the work is not started yet.

The Polish expert promised to circulate his PP presentation among the group members.

## **6. Preparation of expert opinion about the extension of the scope of R.66**

6.1. The chairman proposed to work out and accept common criteria that could be used as the basis on which the experts could form their opinion about the extension of the scope of R.66. He proposed a draft for the criteria on the last Budapest meeting asking the experts to comment, supplement it.

For this meeting he prepared an improved version (GRSG-IG/R.66-4-2/Rev.1.) The German experts and some others thought that the headings of this document could be used for starting points of the discussion, but the explanations and lists of associated documents were not necessary. After discussion the German expert volunteered to prepare a draft on the basis of the example made during the meeting (GRSG-IG/R.66-4-18). The group decided to only make reference to those statistics that do not incorporate media information. The mentioned draft will be circulated to the experts for comments and supplements and it will be discussed in the next meeting. There was no time for a detailed discussion.

6.2. There was a discussion about the process: how should IG/R.66 form and present its expert opinion and present it to GRSG about the extension of the scope of R.66

- a) It is clear that on the question “Is it necessary and possible to extend the scope of R.66 for DD coaches and SB-s?” four kind of answers are possible:
  - yes, for both categories
  - yes, but only for SB-s
  - yes, but only for DD coaches
  - no need for either categories
- b) More experts were on the opinion that a simple vote is needed and the summarized result should be presented to GRSG.
- c) The question was raised: who may vote? The experts in the group may express only their individual expert opinion, they are not authorised to vote on behalf of countries, organisations, etc. (more experts are from one country, one organisation) The experts can not attend every meeting, but their opinion would be useful whether they are just present or not.
- d) The chairman said that he can not give or block the experts right to vote. He mentioned that more GRSG delegates expressed their interest in this subject at the beginning, but they could not attend the meetings and on the other hand some experts joined to the group meantime and their contribution was very useful.

- e) The chairman proposed:
  - every expert and the GRSG delegates who are interested in this subject
  - on the basis of the agreed, common criteria
  - should express his/her opinion, answering on the question given in sub-para. “a”
  - all these opinions should be listed and presented to GRSG as individual expert opinions
  - GRSG – after discussion – according to its rules can make decision.
- f) Due to a lack of time there was no final agreement, the group will come back to this question at its next meeting.

## **7. Enhanced safety of buses in rollover**

7.1.IG/R.66 has the task to present further proposals to GRSG on how to improve the safety of buses and their passengers in case of rollover. The chairman proposed a frame for this job at the last meeting, asking the experts to comment and improve it. Four working documents were prepared on the subject group.

7.2. There was a UK presentation about the problem of occupant ejection in rollover which is serious risk for casualties (In Great Britain, a maximum of some 3 fatalities and 184 serious injuries per year are due to full or partial ejection from coaches and minibuses) CIC made a detailed study how to prevent the passenger ejection. The study was based on computer simulations of the standard rollover approval test described in R.66 Some of the interesting conclusions of the presentation:

- Toughened glass side windows can not retain the occupants.
- 3 pts belt were more effective than 2 pts belts.
- Seat side bolster can restrict the unbelted occupants from ejection but may result in severe head impact
- Glued laminated side windows were insufficient to retain unbelted occupants because the adhesive bond was not strong enough in the computer FEM simulation.

While the presentation contained more interesting details beyond the written working document, on request the author promised to distribute the presentation, too.

7.3. The Hungarian expert prepared 3 working documents to this subject group:

- some experiences with windows and windscreens in bus rollovers
- emergency exits and their use on buses focusing on rollover accidents
- information to the discussion of the effectiveness of 2 pts versus 3 pts belts.

There was no time to discuss the documents.

## **8. Others**

8.1. The group agreed how to proceed with the Report of the meeting considering the holidays in the high summer season.

8.2. IG/R.66 was invited to hold its next meeting in Madrid, in INSIA-UPM. The preliminary time schedule was agreed (mid of January, 2008) The final arrangement will be fixed at the next GRSG meeting.

**LIST OF PARTICIPANTS**

Name	Country	Institution, company, organization
Harry Jongenelen	Netherlands	RDW
Pascal Reyntjens	Belgium	Van Hool
Alan Davis	France	IRISBUS
Bohuslav Kovanda	Czech Republic	TÜV-SÜD AutoCz
Colin Copelin	UK	IRU
Diaries Mihalek	Poland	SOLARIS
Zbigniew Barszcz	Poland	PIMOT
Lesław Kwasniewski	Poland	Warsaw Techn. Univ.
Jean-Paul Delneufcourt	EU	European Commission
Ludomir Kincl	Czech Republic	MoT
Michael Martinu	Czech Republic	VCA
Petr Pavlata	Czech Republic	VCA
Jan Skrivanek	Czech Republic	MoT
Roman Vaca	Czech Republic	USMD-DEKRA
Miroslav Porádek	Czech Republic	USMD-DEKRA
Teresa Vicente	Spain	INSIA-UPM
Patric Botto	France	CEESAR
Luoise Turner	UK	Dept. for Transport
Iain Knight	UK	Transport Research Lab.
Ras Hashemi	UK	CIC
Johannes Lukaszewicz	Germany	BMVBS
Michael Becker	Germany	EVOBUS
Allan McKenzie	UK	SMMT
Annie Luchie	Belgium	CLCCR/AGORIA
Mátyás Matolcsy	Hungary	GTE

The following experts excuse themselves by e-mail

Jerzy Kownaczky	Poland	ITS
Sándor Vince-Pap	Hungary	JÁFI-AUTÓKUT
Juhani Intosalmi	Finland	Vehicle Administration
Jan Petzall	Sweden	Swedish Road Administration
Giulio Mendogni	Italy	IVECO

**SUBJECT GROUPS AND BELONGING WORKING DOCUMENTS,  
PRESENTATIONS**

**1. General information, statistics**

GRSG-IG/R.66 -4 - 6	Dutch
-4 - 8	Italian
-4 -11	Chairman
-4 -12	Belgian
-4 -13	Spanish
French presentation	
UK presentation	

**2. Information about DD and SB rollovers**

GRSG-IG/R.66 -4 -3	Hungarian
-4 -4	Hungarian

**3. Information about the activity of the Polish-American team**

Polish presentation

**4. Preparation of expert opinion about the extension of the scope of R.66.**

GRSG-IG/R.66 -4 -2/Rev.1	Chairman
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**5. Enhanced safety of buses in rollover**

(Based on the document GRSG-IG/R.66 -3 -5/Rev.1)

GRSG-IG/R.66 -4 -1	UK
-4 -5	Hungarian
-4 -7	Hungarian
-4 -9	Hungarian

**6. Others**

## LIST OF WORKING DOCUMENTS

Number	Title	Document by
<i>Madrid meeting</i>		
GRSG-IG/R.66-1-1	The working method of IG/R.66	Chairman
GRSG-IG/R.66-1-2	Preliminary time-table of IG/R.66	Chairman
GRSG-IG/R.66-1-3	Accident statistics and accident analysis (Available sources)	Chairman
GRSG-IG/R.66-1-4	Required protection level for all bus categories in rollover (Possible approach)	Hungarian expert
GRSG-IG/R.66-1-5	The rollover process and the severity of rollover accidents, considering all bus categories	Hungarian expert
GRSG-IG/R.66-1-6	Requirements on extending the scope of R.66 (The first reflections, starting to think about it)	Hungarian expert
GRSG-IG/R.66-1-7	Agenda of the Madrid meeting	Chairman
GRSG-IG/R.66-1-8	Spanish accidents with buses involved injury mechanism analysis	Spanish expert (INSIA)
<i>Warsaw meeting</i>		
GRSG-IG/R.66-2-1	Bus rollover accident analysis (Children injury mechanisms...)	French expert
GRSG-IG/R.66-2-2	Bus rollover statistics from Hungary	Hungarian expert
GRSG-IG/R.66-2-3	World wide information about bus rollovers	Hungarian expert
GRSG-IG/R.66-2-4	Available technical publications	Hungarian expert
GRSG-IG/R.66-2-5	Accidents with buses in Germany	German expert
GRSG-IG/R.66-2-6	German bus accidents, reported by the Hungarian media	Hungarian expert
GRSG-IG/R.66-2-7	Remarks to the ECBOS summary report	Hungarian expert
GRSG-IG/R.66-2-8	Czech Overall Statistic Data	Czech expert
GRSG-IG/R.66-2-9	APSN Workshop (Bus and Track Safety)	Czech expert
GRSG-IG/R.66-2-10	Structural response of paratransit buses in rollover accidents	Polish expert
GRSG-IG/R.66-2-11	Spanish rollover statistics 1995-2004	Spanish expert
GRSG-IG/R.66-2-12	In depth analysis of DD coach rollover	Spanish expert

### ***Budapest meeting***

GRSG-IG/R.66-2-5/Rev.1	Accidents with buses/coaches in Germany	German expert
GRSG-IG/R.66-3-1	Regulatory background to the scope of R.66	Hungarian expert
GRSG-IG/R.66-3-2	Deformation mechanism of bus superstructures in rollover	Hungarian expert
GRSG-IG/R.66-3-3	Rollover accidents in Norway	Norwegian expert
GRSG-IG/R.66-3-3/Add.1	Extended Norwegian working document	Norwegian expert
GRSG-IG/R.66-3-4	More detailed analysis of DD coach and SB rollover accidents	Hungarian expert
GRSG-IG/R.66-3-5	Possibilities to enhance occupant safety in bus rollover accidents	Hungarian expert
GRSG-IG/R.66-3-5/Rev.1	Improved version of the original doc.	Hungarian expert
GRSG-IG/R.66-3-6	Double deck bus accident in Germany	German expert
GRSG-IG/R.66-3-7	Accident investigation on minibuses (M2 Class B)	German expert
GRSG-IG/R.66-3-8	Considerations to the extension of the scope of R.66	Chairman
GRSG-IG/R.66-3-9	Test results and remarks on midi bus rollover safety	Hungarian expert
GRSG-IG/R.66-3-10	Crash and safety assessment program for paratransit buses	Polish expert
GRSG-IG/R.66-3-11	Draft crash and safety standard for paratransit buses	Polish expert
GRSG-IG/R.66-3-12	US-Polish task group for small bus rollover simulation address to the Informal Group	Polish expert
GRSG-IG/R.66-3-13	UK contribution to IG/R.66 meeting in 2007 Budapest	UK expert
GRSG-IG/R.66-3-14	Coach roof structure deformation analysis for real world coach accidents to ECE R.66 regulation	French expert
GRSG-IG/R.66-3-15	Some information about two new DD coach accidents	UK and Hungarian experts
GRSG-IG/R.66-3-16	Bus sales and registrations in Czech Republic	Czech expert

### ***Prague meeting***

GRSG-IG/R.66-4-1	Preventing passenger ejection from buses, coaches and minibuses	UK expert
GRSG-IG/R.66-4-2/rev.1	Considerations to the extension of the scope of R.66 to all bus categories	Chairman
GRSG-IG/R.66-4-3	Applicability of the approval tests to DD coaches and small buses	Hungarian expert
GRSG-IG/R.66-4-4	Summarized statistical information about DD and SB rollover accidents	Hungarian expert

GRSG-IG/R.66-4-5	Some experiences with windows and windscreens in bus rollovers	Hungarian expert
GRSG-IG/R.66-4-6	Dutch overall statistical data with regard to buses and coaches	Dutch expert
GRSG-IG/R.66-4-7	Emergency exits and their use on buses focusing on rollover accidents	Hungarian expert
GRSG-IG/R.66-4-8	Buses and coaches – running park and new registrations	Italian expert
GRSG-IG/R.66-4-9	Information to the discussion of the effectiveness of 2pts versus 3 pts belts	Hungarian expert
GRSG-IG/R.66-4-10	Not finished and not circulated	
GRSG-IG/R.66-4-11	Data about the number of registered buses, bus categories and bus rollover accidents	Chairman
GRSG-IG/R.66-4-12	Official statistical data on minibuses, buses and coaches	Belgian expert
GRSG-IG/R.66-4-13	Questionnaire for European experts on coaches and buses	Spanish expert
GRSG-IG/R.66-4-18	Summary document	German expert

**DATA ABOUT THE NUMBER OF REGISTERED BUSES, BUS CATEGORIES  
AND ABOUT BUS ROLLOVER ACCIDENTS**

**1. Norway** (GRSG-IG/R.66-3-3 and -3-3/Add.1)

Total number of buses (2005)	28.783
Class I.	1.809
Class II	3.876
Class III	2.024
Small bus	
17<PC<22	2.832
PC<17	18.242

Rollover accidents (2002-2005)

Class II and III	33
Class A and B	9

Casualties in rollover

Fatality	5
Serious injury	13
Slight injury	166

In the presentation 6 bus rollover accidents were shown, one among these happened to a DD coach in 2006.

**2. Czech republic** (GRSG-IG/R.66-3-16)

The yearly bus registration figures in Czech Republic

	<b>2004</b>	<b>2005</b>	<b>2006</b>
All new and used buses	1037	908	1129
Only new buses	954	816	944
Class I.	237	159	279
Class II	569	489	476
Class III	57	67	91
M2	63	51	39
Others	28	50	59

### 3. Germany

#### 3.1. Data about bus fleet

The number of registered DD buses and coaches together in Germany is 1850 (January, 2007). The estimated ratio of DD city buses in this figure could be 2-3 %, the high majority is tourist coach. The production of DD coaches is in the range of 180-200 units/year. The number of small buses (M2) is under investigation.

#### 3.2. Accident and casualty data (GRSG-IG/R.66-2-5/Rev.1; GRSG-IG/R.66-3-7)

German overall accident data, 2004

All road accidents in this year: 2.261,689

	All road users	Bus and coach occupants
fatalities	5.842	16
Serious injuries	80.801	460
All casualties	445.968	4.994

GIDAS (Hanover and Dresden area) data base (1995-2005)

Reconstructed road accidents:	8.717
Among these buses and coaches:	20
minibuses:	6

Rollover accidents of buses

large buses	2
among these DD	1
minibuses (class B)	3

### 4. Belgium (GRSG-IG/R.66-4-12)

#### 4.1. The bus fleet in 2004

large buses and coaches	15.281
minibuses	18.794
total:	34.075

Yearly new registrations (2002-2004)

large buses and coaches	900-1100
minibuses	300-1400

Remarks: minibus means 0 < 3,5 tons  
large bus and coach means < 3,5 tons  
in which the rate of small buses is about 10%

#### 4.2. Casualty figures (2000-2002)

KSI in all road users	31.315
KSI in all buses	157
Fatality in all road users	4.309
Fatality in large buses	6

## 5. UK (the data were given by SMMT, at end 2005)

Number of registered large buses (M3)	101054
among these DD bus and coach	19600
(DD coach around 5%)	
Large bus yearly registration	6000-7500
Number of registered small buses (< 17 passengers)	88500
Small bus yearly registration	5000-6500

## 6. Hungary (GRSG-IG/R.66-3-4)

<b>6.1. The total bus fleet in Hungary (2005)</b>	17.855	
Estimated values for different categories		
Class I	3500-4000	
Class II	9000-9500	
Class III	1400-1450	
among these HD	300-350	
DD	20-25	
Class A	-	
Class B	3100-3200	
Others, not specified	100-200	
New registrations per year	800-900	
DD ratio in fleet of Class II and III	25/10.600	≈ 0,23%
DD accident ratio in all rollovers	3/97	≈ 3,20%
SB ratio in total fleet	3200/17,855	≈ 7,90%

## 6.2. Bus rollover accidents in Hungary

All bus rollovers (2001-2006)	94	
DD rollovers	3	
Small bus (SB) rollovers (2002-2006)	50	
DD ratio in the total fleet	25/17.855	≈ 0,15%
DD accident ratio among Class II and III	3/37	≈ 8,10%
SB accident ratio in all rollovers	50/94	≈ 53,2%

## 7. Italy (GRSG-IG/R.66-4-8)

The total bus fleet in 2005 and its distribution

Class I.	15.610
Class II.	14.618
Class III.	7.965
DD coach	n.d.a.
Small buses	15.343
<b>Total:</b>	<b>53.536</b>

In small buses class A and B as well as small school buses are considered, too.  
The yearly registration of these categories in the years 2000-2006

Class I	1100-1600
Class II	1200-1600
Class III.	620-950
Small buses	1150-1570
<b>Total:</b>	<b>4850-5570</b>

## 8. Netherlands (GRSG-IG/R.66-4-6)

### 8.1. Data about the bus fleet

	<b>2003</b>	<b>2004</b>	<b>2006</b>
Class I. and II.	5500	5393	
Class III.	4700	5000	
	10.200	10.396	10.845

### 8.2. Casualty figures for these buses (1997-2006)

	Total number	average/year	% among all road users
Fatalities	26	1,3	0,113
Hospitalized injuries	353	18,6	0,151

## 9. Spain (GRSG-IG/R.66-4-13)

### 9.1. National fleet of buses and coaches (2005) **58.248**

Total number of passenger km  $53 \times 10^9$

### 9.2. Number of bus and coach accidents 1.822

on urban roads	1.402
on rural roads	420
rollover bus accidents	177
fatalities among bus occupants	26
serious injuries	153
KSI in bus rollovers	62

## 10. Florida (USA)

The number of newly registered para-transit buses (passenger capacity 16-20) in Florida is around 300 unit/year.

## 11. CLCCR information

The ratio of DD coaches and SB-s in the total fleet is different country by country according to their traditions, passenger transportation systems, and their market demand. There are no generally valid figures for all countries. As a first approach, for Western Europe:

DD ratio in total fleet	5%
M2 ratio in total fleet	6%
22 seater's ratio in total fleet	10%

## 12. IRU information

DD coaches are mostly in service on international long distance travels and are using motorways, which explains why they appear to be more present on the roads than as it is the case in reality and why they are less involved in rollover accidents than the other vehicles.

## 13. World wide figures (GRSG-IG/R.66-3-4)

The Hungarian expert collected a lot of statistics and information published by different authors which were available and published, presented since 1973. The total number of these bus rollover accidents is 570. During the first 25 years DD coaches were not in operation, so 400 rollover accidents may be considered, in which 29 DD coach rollovers happened:

DD accident ratio in all rollovers    29/400         $\approx 7,25\%$

The SB's rollover investigations started in 2002, 67 rollover accidents were reported since that time (including the Hungarian ones, too) while the total number of bus rollovers during this period is 249.

SB accident ratio in all rollovers    67/249         $\approx 26,9\%$

Bus categories	Hungary 2004		Norway 2005		UK 2005		Italy 2005		Nederland 2006	
Class I	3.500-4000	20-22%	1809	6,3%	101.100	53%	15.610	29%	≈5.500	≈51%
Class II.	10.400-10.900	58-61%	3876	13,5%			14.618	27%		
Class III.			2024	7%			7.965	15%		
DD coach	20-25	0,15%	15-25	0,09%	≈ 950	0.5%	n.d.a.		n.d.a.	
Small bus	3100-3200 <sup>(2)</sup>	17-18%	21.074	73,2%	88.500	46.5%	15.343 <sup>(1)</sup>		n.d.a.	
Total fleet	17.800	100%	28.783	100%	189.500	100%	53.536	100%	10.800	100%
Yearly new bus registrations	800-900		n.d.a		11.000-14.000		≈5.000			

n.d.a. = no data available

(1) including small school buses, too

(2) no class A in use