

AHEG-38/Rev.1.
January, 2003
REPORT

about the ad-hoc expert group (AHEG) meeting
dealing with the development of ECE Regulation 66.
(Warsaw, 28-29 October)

1. Participants of the meeting

Australia	Prof Grzebieta, Raphael
Belgium	Ms. Reyntjens, Pascale
Czech Republic	Mr. Pavlata, Petr
Germany	Mr. Steinmetz, Gregor
Hungary	Dr. Matolcsy, Mátyás
Nederlands	Mr. Huibers, Jos
Poland	Mr. Przybylski, Wojciech
	Mr. Kownacki, Jerzy
Spain	Mr. Gracia, Andres
	Mr. Martinez, Vincente
UK	Mr. Burch, Malcolm

Prof. Grzbieta attended only the second day of the meeting. The host of the meeting was MTI (Motor Transport Institute in Warsaw, Poland) and the chairman was Dr. Matolcsy. The following persons indicated that they could not attend the meeting but they were interested in the work of AHEG and they needed the documents of the meeting:

Dr Hanke, Mirroslav	Czech Republik
Mr. Intoshalmi, Juhani	Finnland
Mr. Minne, Francois	France
Mr. Becker, Michael	Germany
Mr. Mendogni, Giulio	Italy
Mr. Biver, Michael	OICA
Mr. Lafuente, Ignatio	Spain

2. Documents

The new AHEG documents being produced after the Barcelona meeting are listed in the Annex of this Report. They were distributed before the meeting and served as working documents.

3. The agenda of the meeting

The following subjects were discussed on the meeting. (The related new documents are in brackets)

- General exchange of information AHEG-33/Rev.1.
- The consolidated document (CD) of the modified Reg.66 AHEG-18/Rev.2.
- The effect of safety belts AHEG-34,
AHEG-34/SP
- The required accuracy when determining the CG's position

- The quasi-static approval methods: Annex 7 and Annex 8 AHEG-35
AHEG-36/Rev.1.
AHEG-15/Rev.1/TNO
- New description of the residual space Appendix of AHEG-26
- Computer simulation of the rollover approval test: Annex 9. Hungarian proposal
- Rollover accident of a Polish coach in Hungary AHEG-37
- Summary of the AHEG activity

As an addition to the program Prof. Grzebieta gave a presentation about the general behaviour of plastic hinges.

4. General exchange of information

The chairman informed the group about the last GRSG session (October, 2002) related to subject of bus rollover and Reg.66. The main things:

- 5 informal documents have been presented to GRSG in this subject: 2 from AHEG (see in the Annex) and three from Hungary (Rollover statistics, Report about the Polish coach rollover accident, Hungarian concerns about HD coach approvals)
- The chairman of AHEG and the chairman of GRSG agreed that the new CD of Reg.66. will concentrate mainly on technical issues, more than the administrative paragraphs.
- The chairman informed AHEG about the new, two step approach in the elaboration of the combined, united ECE bus regulation including the problem of the strength of the superstructure.

5. The CD of the new Reg.66.

The final result of the AHEG's activity will be the CD which will be presented to GRSG for further study and discussion. During the session the following was done and agreed:

- By common request the group read the CD paragraph by paragraph and accepted some corrections, modifications, including the written proposals of the Belgian expert.
- The UK delegate manages the CD, the Hungarian delegate gave him a complete copy of the CD with the Hungarian comments and proposals covering mostly editorial issues (not essential changes)
- AHEG agreed that the final version of the CD should be complete in the technical content, unified in outward form and appearance including the figures with the same style.
- The Polish delegate undertook the preparation of the figures by computer
- The schedule of the final version of CD was agreed as follows:
 - 31.12.2002: everyone may send further comments, corrections to Mr. Burch (UK delegate). The Hungarian delegate prepares Annex 7 and Annex 8 until this deadline and will circulate them.
 - 31.01.2003: Mr. Burch prepares the final text, Mr. Kownacki (Polish delegate) makes the figures and circulates them.
 - 15.02.2003: Mr. Burch puts the figures into the CD and circulates the it.
 - 15.03.2003: everyone may comment the CD sending the proposals to Mr. Burch and to the chairman.
 - 15.04.2003: sending the CD to the secretariat in Geneva.
 - 5-9. 05.2003: presentation and discussion of the CD in GRSG:

6. The effect of the safety belts.

Discussing this subject the following should be recorded:

- 6.1. UK and Hungary presented a common proposal (AHEG-34) in which they suggested to have a mass proportion in the range of $k = 0,5 - 0,6$ independently from the type of the restraint system (two or three point belts) Spain produced an agreed, uniform Spanish proposal (AHEG-34/SP) in which they suggested $k = 0,5$ in case of two point belts and $k = 0,9$ for three point belts.
- 6.2. The Czech expert presented again their earlier computer simulations and came back to their earlier conclusions:
 - There is a significant difference between the behaviour of belted and unbelted dummies
 - There is no significant difference between 2 or 3 point seat belt effect.
- 6.3. The Belgian and German experts underlined that most of the tests and all the simulations were made with body sections and not with complete vehicle. The mass proportions could be different in these two cases and that could effect the value of “k”.
- 6.4. The Hungarian expert emphasized that the value of “k” depends mainly on the stiffness of the “load path” of the restraint system. If the load path is absolute rigid than $k = 1$, and if it is very flexible and soft, the value of “k” tends to zero. The stiffness of the restraint system results a certain time-delay in the load transfer of the dummy’s mass force and in the same time it works itself as an energy absorbing system. Until now we do not have directly measured dynamic stiffness of the restraint systems, our estimations on the value of “k” are based on measured structural deformations or energies absorbed by the plastic hinges, or in other words: based on indirect measurements.
- 6.5. The expert from Australia expressed their experiences with two point belts versus three point belts in car rollover and he expected similar situation in buses. Two point belts are better than nothing but they are not as good as three point systems, which are much better at reducing facial and head injuries.
- 6.6. After a long discussion the majority of the experts accepted the value of $k = 0,5$ as a compromise for every kind of restraint system. AHEG calls the attention of GRSG, WP29 and the national authorities that further researches are needed on this field and this kind of activities should be supported both on national and international level. The Belgian and German experts expressed that they are not in the position now to accept any kind of “k” value, they need more time to study this subject. The Belgian expert calls the attention of AHEG to a remark on a legal level: there is no ECE regulation nor EC directive enforcing the wearing of the belt. So how consider those passengers? Who will be responsible in the bus for enforcing the wearing of seat belts?

7. Accuracy of measurements when determining CG’s position

The demand for a certain accuracy of measurements was raised by GRSG when Annex 3. of Reg. 66 was discussed. The degree of accuracy, taken from ISO standard seemed to be excessive for many experts. After a discussion AHEG agreed on the following:

- The accuracy requirements given in Annex 3. relate to the accuracy capabilities of the measuring tools
- The main geometrical dimensions of the bus which are used in the determination of the CG’s position (e.g. wheel base, track, etc.) may be taken and used from the technical description of the bus given by the manufacturer.

8. The quasi-static approval methods: Annex 7 and Annex 8.

On its Barcelona meeting AHEG had a long discussion about the quasi-static approval methods (described in Annex 7 and Annex 8 of the new regulation), about the energy absorption coefficient 0,75 and drop of the CG (Δh). The experts were asked to express the

official opinion of their country about the use of the quasi-static approval methods in Reg.66. Discussing this subject, the following was done and agreed:

- 8.1. Nine countries expressed their opinion about the quasi-static approval methods (AHEG-36/Rew.1)
 - No one insists on deleting Annex 7 and Annex 8 from the regulation
 - Two of them (Spain and Hungary) could accept these Annexes to be deleted
 - Seven of them clings to keep these Annexes in the regulation.
- 8.2. UK and Hungary proposed two ways in a common document (AHEG-35) to determine the total energy (E_T) to be absorbed:
 - a) no change in determination of Δh but the energy absorption coefficient should be increased to 0,85
 - b) no change in the energy absorption coefficient but Δh should be determined by successive approximation. This method is widely used in mechanics.
- 8.3. During the discussion the experts expressed the following opinions:
 - Spain and Belgium did not want any change in the two parameters
 - The Czech expert supported the “a” version of the UK-Hungarian proposal
 - The expert from Netherlands proposed a simplified “b” version of the UK-Hungarian proposal and his further comments are given in AHEG-15/Rev.TNO.
 - Germany underlined that the quasi-static methods must not be “easier, more favourable” test methods than the dynamic one. He supported the earlier Czech opinion that the two parameters shall be determined on that way that it shall not be in the interest of the manufacturer to choose these quasi-static methods.
- 8.4. The chairman concluded the discussion: there is no strong majority supporting any new proposals in this subject. He reminded the experts on the GRSG demand that if there is no strong majority behind a new proposal, the change should not be done in Reg.66. Therefore the only change in the determination and use of the parameters 0,75 and Δh , that the real shape (cross section) of the body shall be used in this process, in underformed position.
- 8.5. The Hungarian expert undertook the task to produce the new version of Annex 7 and Annex 8 on the basis of this agreement and also the earlier agreed items, and circulate them before the end of this year.

9. New description of the residual space.

On the Barcelona meeting the Hungarian expert proposed a new, modified description of the residual space in which the dimensions, the character of this space remained the same, the new idea was that every seat or seating position should have an individual residual space (Appendix of AHEG-26) It was agreed to finish the discussion on this meeting. While this proposal does not have an essential importance and because for the lack of time, Hungary withdrew the proposal.

10. Computer simulation of the rollover approval test

On its Barcelona meeting AHEG accepted a German, Czech, Spanish and Holland proposal for Annex 9 and put it in the CD. The expert of Hungary offered new comments and proposals to this Annex. The new Hungarian proposals (“Hungarian proposals to Annex 9 of the DC) were circulated before the meeting and discussed as follows:

- 10.1. The main items of the Hungarian concerns and proposals were the following:
 - a) Only the simulation of the standard rollover test is acceptable as an approval test. The computer simulation of the substituting approval test is not acceptable. (It was already earlier agreed)

- b) The structural model used for the simulation should contain the boundary surface of the residual space, as well as those structural parts which may intrude into the residual space
 - c) The rollover process shall be given in an Appendix as a mechanical process with the main mechanical criteria. It shall be clear what is to be simulated
 - d) The plastic zones and hinges (their location, type, characteristic) shall be given by the manufacturer based on laboratory tests, and shall be included into the structural model. This task should not be left to the widely used FEM programs because generally their capability is not yet suitable nowadays to generate the real behaviour of plastic hinges.
 - e) The energy dissipation (friction work, energy absorbed by oscillation and damping, by local work and fractures, by the ground, etc.) shall be clear and limited, the energy absorbed by the superstructure (PH-s and PZ-s) shall be controllable
 - f) The requirements of the algorithm and computer program used in the approval simulation shall be clear and well defined.
 - g) The transparency of the computer simulation for the Technical Services (that of the approving country and also the contracting parties) shall be guaranteed.
- 10.2. In the discussion AHEG accepted only paragraph “a” from the Hungarian proposal. The majority of the experts had the opinion that the Technical Services have the knowledge and capability to judge the questions raised by Hungary. The computer simulation shall not be over-regulated in Annex 9.
- 10.3. Hungary emphasised that contrary to the over-regulation there is a much higher danger, the under-regulation, the consequence of which an animation could be presented for approval instead of a simulation. The Hungarian expert announced his reservation with the present form of Annex 9.

11. Rollover accident of a Polish coach in Hungary

After a brief presentation in GRSG, the Hungarian expert got some new technical information about the coach from the Polish expert so it was possible to improve his earlier report. This improved version (AHEG-37) has been presented to AHEG. The Czech expert had the feeling – based on the geometry of the pillars – that the superstructure was too weak, it could not have been approved according to Reg.66. As the manufacturer stated the coach was not approved. The Hungarian expert expressed his opinion that the high decker coach could have been approved, even with the weak superstructure, because of the effect of limited structural deformation of HD coaches.

12. Presentation of Professor Grzebieta

Professor Grzebieta (Monash University, Australia) gave a presentation to AHEG about the general behaviour of how plastic hinges formed in metal structures. Using measured data he pointed out the great effect of the geometry (relative thickness, shape of the cross section of the beam, etc.) the material properties (combination of materials) on the characteristics of plastic hinges. He provided copies of four Australian Design Rules (ADR) to the experts of AHEG:

- ADR 59/00 Omnibus rollover strength
- ADR 58/00 Requirements for omnibus designed for hire and reward
- ADR 66/00 Seat strength, seat anchorage strength and padding in omnibuses
- ADR 68/00 Occupant protection in buses

13. Summary of AHEG’s activity

- 13.1. At the end of the last AHEG meeting the chairman summarized the results of this session and promised to prepare the Report and circulate it to the participants before

Christmas to comment on it. The comment can be returned by the mid of January, so the final Report can be sent to all of the AHEG members before February. It will be also presented to GRSG on its May meeting.

13.2. The chairman looked over the whole activity of AHEG:

- In 1996, on its 71st meeting (in October) GRSG decided to revise and develop Reg.66. In November this year, Spanish, UK and Hungarian experts had an informal meeting and prepared a proposal about the possible way of working and presented it on the 72nd meeting of GRSG
- On its 73rd meeting (Oct, 1997) GRSG founded an informal ad-hoc expert group (AHEG) to prepare the developed, revised version of Reg.66.
- The first AHEG meeting was organized in Budapest (January, 1998) and this was followed by the Cranfield, Madrid, Prague, Brussels, Frankfurt, Barcelona and Warsaw meetings (between the autumn of 1998 and 2000 the work was suspended for two years) The effective work took 2,5 years.
- During the 8 meetings 33 experts of 12 countries (Australia, Belgium, Czech Republic, Finland, France, Germany, Hungary, Italy, Netherlands, Poland, South Africa, Spain) participated in the common work.
- During the work 59 written working papers were produced and discussed and about 10 video and computer simulations were shown.

13.3. There is no change in Reg.66. in:

- the scope
- the standard rollover test (approval test)
- the definition of the survival space
- the requirements

The most important changes in Reg.66 are the following:

- the seat belt effect is considered
- only the specified approval methods may be used
- the precise description of the accepted approval tests in the Annexes guarantees the repeatability of the tests
- pendulum test is deleted
- the equivalency of substitutive approval methods to the standard rollover test is stated and assured
- the precise determination of CG's position is described and required for approval
- the precise description of a superstructure is given and required for approval
- the exact definition of "worst case" gives the possibility of "umbrella" approvals covering more vehicle types
- clear description of test of articulated buses

13.4. The chairman gave his subjective evaluation about the result of the common effort having the feeling that the majority of the experts have the same one: it is not the optimal solution but a good, acceptable compromise. The new version of Reg.66. is much better than the existing one, the improvement results in a great step towards the rollover safety of buses.

13.5. Finally the chairman thanked the experts for all of their contributions to the work and thanked the hospitality of the countries and institutions who have received AHEG in their house.

Budapest, 24.01.2003

Dr Matolcsy Mátyás

WORKING DOCUMENTS

- I. Since the last (Barcelona) meeting of AHEG the following working documents have been produced and circulated to the AHEG members before the Warsaw meeting:

AHEG-15/Rev1/TNO	Holland proposal for Annex 8.
AHEG-18/Rev.2.	Review and revision of ECE Reg.66 Consolidated Document presenting the work to date of the ad hoc Expert Group
AHEG-33/Rev.1.	Report about the AHEG's Barcelona meeting
AHEG-34	Proposal for the consideration of the mass of belted passengers (Common UK and Hungarian paper)
AHEG-34/SP	Spanish proposal in the same subject
AHEG-35	Comments and proposal to Annex 7. and Annex 8. (Common document of UK and Hungary)
AHEG-36/Rev.1.	Summary of the countries opinion about Annex 7. and Annex 8.
AHEG-37	Brief description about a serious bus rollover accident (Hungarian document)

Hungarian proposals to Annex 9. of the CD

- II. After the Barcelona meeting AHEG presented two documents to GRSG for its 83rd meeting:

Informal doc. No.5.	Report of the AHEG Barcelona meeting
Informal doc. No.8.	Consolidated document of the modified Reg.66. (See AHEG-18/Rev.2.)