

## **DRAFT REPORT**

### **5<sup>th</sup> meeting of the GRRF informal group on**

### **Advanced Emergency Braking and Lane Departure Warning Systems**

Venue: VDA Offices, Behrenstrasse 35, 10117 Berlin  
Dates: 13-15 April 2010  
Chairman: Mr. Johan Renders (EC) (johan.renders@ec.europa.eu)  
Secretariat: Mr. Olivier Fontaine (OICA) (ofontaine@oica.net)

#### **1. Welcome and Introduction**

Mr. Heiner, on behalf of VDA (Verband der Automobilindustrie) welcomed the participants to the new headquarters offices of VDA.

The Chair shared his hope of achieving the two main targets of the meeting, namely finalizing the draft regulatory text for Lane Departure Warning Systems (LDWS) and clarifying the positions of the participating contracting parties and Industry about Advanced Emergency Braking System (AEBS) in its phase 1 of completion of the work, namely definition of provisions in the case of M3/N3 approaching a “moving target” and in its phase 2, namely definition of provisions in the case of M3/N3 approaching a “stationary target”.

The chair welcomed the valuable and numerous contributions provided by the parties.

#### **2. Approval of the agenda**

Document: AEBS/LDWS-05-01 (Chair)

J informed about the three new Japanese contributions (AEBS/LDWS-05-02, AEBS/LDWS-05-03 and AEBS/LDWS-05-04) and requested in-depth exchange of views about the presentation on speed reduction performance (AEBS/LDWS-05-04).

#### **3. Outcome of GRRF 67**

Documents: GRRF-67-04 & GRRF-67-20

The Chair orally reported about the outcomes of the 67<sup>th</sup> session of GRRF (Geneva, 2-5 February 2010):

- GRRF recommended to delete the provisions requiring the Contracting Parties to inform the UN Secretary General in case they mandate the systems in their territory. As a consequence, Paragraph 1.3. in LDWS draft text and Paragraph 1.2. in AEBS draft text were recommended to be deleted
- The UNECE Secretariat considered the proposed introductory provisions are not conform to the WP29 guidelines on Transitional Provisions (document TRANS/WP29/1044) GRRF confirmed that because paragraph 12 redundant with the '58 Agreement provisions. The Chair suggested to consider this item again within the informal group.

- The GRRF Chair pointed out the narrow time frame in which the informal group must finalize its work and urged the experts to clarify the outlines of the requirements about AEBS.

#### 4. Outcome of the Task Force meeting on LDWS visible lane markings

The Chair orally reported about the outcomes of the Task Force meeting on LDWS visible lane markings held in Stuttgart (Daimler premises) on 18 March 2010:

- The Chair welcomed the positive outcomes of the meeting
- He recalled that the group faced the problem of mutual recognition vs. different systems according to the region where the vehicle will be operated.
- He summarized the proposed solution: any vehicle type should be capable of being operated in all lane markings referred in the annex of the regulation. For testing purposes, test will be performed on one lane marking, and the manufacturer will provide necessary supplementary documentation for the other lane markings. A manufacturer can request Type Approval for different variants of the LDWS.

CLEPA pointed out that the colour of the markings was not considered during the Task Force meeting.

Conclusion: the informal group endorsed the principle of the proposed solution

#### 5. LDWS:

##### 5.1. outstanding issues from previous meetings

###### 5.1.1. Performance requirements

(§ 5.2 of AEBS/LDWS-02-03-Rev.3)

The performance requirements were accepted by the informal group with small editorial improvements

###### 5.1.2. Warning strategy

(§ 5.4 of AEBS/LDWS-02-03-Rev.3)

Document: ITS-18-04 (J)  
AEBS/LDWS-05-05 (UK)  
AEBS/LDWS-05-06 (UK)  
AEBS/LDWS-05-07 (D)

##### Position toward ITS informal group guidelines

The Chair organized a tour de table with the aim of getting an idea of the wish of the group concerning the draft guidelines from the IHRA informal group on ITS (ITS-18-04):

- CLEPA: keen to keep the AEBS/LDWS informal group independent from its possible influence on the exterior, stressed that the purpose of this AEBS/LDWS group is not to export the LDWS proposed solutions to other groups
- OICA: the informal group on AEBS/LDWS is the right place to solve the issue of warning strategy and Human Machine Interface because the real experts on LDWS with regard to these issues are participating to this meeting
- J: keen to follow the ITS informal group guidelines, but deplored that they are not yet finalized
- NL: supported OICA that the HMI decision must be done within the AEBS/LDWS informal group
- F: neutral position

- UK: keen that the group takes into account AEBS/LDWS-05-05
- ROK: neutral position

Conclusion: the informal group agreed to solve the issue of HMI within the group.

#### Warning modalities

The group started the debate based on the proposal presented by D (AEBS/LDWS-05-07).

- OICA, CLEPA: supported the proposal
- J: rejected the proposal:
  - Contradictory to current status of ITS guidelines
  - Single modality found too risky: a haptic warning would not be noticed on rough roads and an acoustic warning would not be noticed when driving with e.g. radio
- UK: rejected the proposal per document AEBS/LDWS-05-06. A single warning is more likely to be missed by a distracted driver and therefore will reduce the effectiveness of the system. Requiring “at least two modes” (rather than being prescriptive) provides flexibility for manufacturers to determine the most effective HMI for their vehicle type.

The group gathered the proposed solutions as follows:

“The lane departure warning referred to in paragraph 6.5. shall be either an acoustic, haptic or optical signal which is easily perceived by the driver” +

- Proposal 1: “variable vibration and sound patterns that provide an indication to the direction of the drift”
- Proposal 2: “and provides spatial cues to the hazard location”
- Proposal 3: “the warning shall be clearly distinguishable to the driver by a haptic, audible, or visual modality, or any combination thereof (per wording of ISO 17361:2007, para. 4.3.3.)
- Proposal 4: “The lane departure warning referred to in paragraph 6.5. shall be either an acoustic, haptic or optical signal and shall ensure that it is noticeable by the driver and provides spatial cues to the hazard location. In the case that an optical warning signal is used, it shall be complemented by either an acoustic or a haptic warning signal”.

Proposal 4 was supported by D and NL, rejected by UK as it does not address the problem of acoustic modality on its own

OICA informed that the majority of the vehicles in current production offer one warning modality out of three (optic, acoustic, haptic). The delegate from OICA pointed out that the warning modality should best be based on current experience of the drivers, i.e. haptic and acoustic warning should mirror the effect produced by the current side strips, in order to avoid supplementary driver education or driver’s wrong reaction.

Brand A: haptic only and acoustic only. As false alerts are very frequent in some secondary roads, the bus/coach driver tends to switch off the LDWS in order to avoid unnecessary burden to the passengers. This is of particular importance because frequent acoustic warnings make the passenger believe of frequent driving errors.

Brand B: conducted researches with all combinations: discovered no clear difference in term of reaction time between the different solutions.

Brand C: equips vehicles of category M3 with haptic warnings, and category N3 with acoustic warnings. The brand experiences no problem with this solution.

Brand D: vehicles of category N3 are equipped with both acoustic and haptic modalities.

Brand E: equips its vehicles with acoustic warning signal only.

UK informed that their Department for Transport took the opportunity to try several vehicles providing one warning modality only, and were not convinced by such a solution. The delegate

suggested to improve the definition of “easily perceived” by requiring an additional indication of the hazard location.

#### Conclusion:

After lengthy debates the group agreed that the fundamental criterion for the departure warning is that it must be “well noticeable”. The group in addition agreed on the two paths for achieving such target: Either one warning means out of haptic and acoustic with spatial indication about hazard location, or two warning means out of three. It was considered that the above agreements were best achieved by the wording below:

“5.4.1. The lane departure warning referred to in paragraph 5.2.1. shall be noticeable by the driver and be provided by:

- [at least] two warning means out of optical, acoustic and haptic, or
- one warning means out of haptic and acoustic, with spatial indication about hazard location”

The text in square brackets will be subject to final agreement at the 6<sup>th</sup> meeting of the informal group.

#### **5.1.3. Test procedure – visible lane markings** (§ 6.1.3 & Annex 3 of AEBS/LDWS-02-03-Rev.3)

The group found no reason to specify a maximum test lane width. The reasons for that are the following:

- The vehicles are usually tested on public roads
- Usually only one line is sufficient to conduct a representative test
- NHTSA requests a “continuous solid white line” for testing the LDWS of light vehicles (see “LDW Test Procedures - NHTSA-2006-26555-0119”)
- For development, the manufacturer will test the worst case.

The group however found appropriate to define a minimum lane width of 3.5 m as this avoids interference of one side detection when the opposite side is actually being tested.

#### **5.2. skeleton paper: final review and update**

Document: AEBS/LDWS-02-03-Rev.3 (Secretariat)

D raised the case of a vehicle fitted with both lane keeping system and lane departure warning system and deplored the necessity for the manufacturer to apply for double type approval when seeking type approval for such vehicle (regulations on LDWS and Regulation N°79 – steering system).

The Chair recommended D to address this case directly to GRRF. He also informed that the WP29-ITS informal group considers lane keeping systems as not high priority warning systems because it interferes with the steering system.

OICA suggested to add a provision for disabling the lane keeping system when LDWS is being approved.

The informal group Secretariat was tasked to clean up the document, then send it to the group for revision, seeking for final approval at the 6<sup>th</sup> meeting of the informal group in June 2010.

## **6. AEBS:**

### **6.1. outstanding issues from previous meetings**

6.1.1. *Proposed test scenarios for moving and stationary targets*

AEBS-LDW-04-08 -	(Secretariat) AEBS proposed test scenario Table
AEBS-LDW-04-10 -	(CLEPA) Stopping distance – TTC
AEBS-LDW-04-11 -	(CLEPA) Proposed amendments to AEBS “skeleton” document for a reduced number of type approval warning and brake application tests
AEBS/LDWS-05-02	(Japan) speed measurement tolerances
AEBS-LDW-05-03 -	(Japan) The subject vehicle and the moving target
AEBS/LDWS-05-04-	(Japan) proposal for warning timing
AEBS-LDW-05-05 -	(UK) UK Comments on AEBS provisions

The group undertook a systematic revision of the document AEBS/LDWS-04-08. PL provided with positions via an email subsequent to the meeting, dated 25 May 2010.

PHASE 1: MOVING TARGET SCENARIO

Obstacle speed: J tabled document AEBS/LDWS-05-02 showing the speed measurement equipment tolerances and their influence on the minimum target speed to ensure discrimination between a stationary target and a moving target.

PL supported an obstacle speed between 10 km/h and 15 km/h constant.

Conclusion: . J committed to revise their position by June 2010 meeting

Subject vehicle initial speed :

Study of AEBS/LDWS-04-08 reveals the existence of two main positions concerning this item, namely the parties in favour of conducting one test only, at high subject vehicle initial speed, and the parties in favour of conducting two tests, at high and low subject vehicle initial speeds (UK/J).

A debate took place seeking for a possible compromise test speed.

J justified the two test speeds as tests representative of highway vs. secondary road situations. Secondary road presents a higher risk of false alerts, hence an adapted system strategy. As a consequence the regulatory requirements should be adapted as well. The expert indicated that the secondary road situation is actually more severe than the highway situation in terms of detection reliability.

OICA informed that OEMs must optimise speed reduction and false alarms. A simple optimisation of the false alerts rate could be reached e.g. by decreasing the system capabilities at speeds lower than 80kph. However, as the user could well drive at 80kph on secondary roads as well, this strategy would be dangerous for the manufacturer.

F announced that they changed their position, turning to a one test (high) test speed only.

UK welcomed the argument from OICA about the possibility that the manufacturer decreases the system capabilities at low speeds for the sake of the type approval test, but maintained their position in favour of two test speeds.

A debate took place on whether a lower test speed permits to well represent the secondary road situation. D pointed out that an approval test only simulates the real world situation, and is a laboratory test with ideal conditions. OICA confirmed this by giving the example

of ESC: ESC in real world must function in 1000s various situations, and developers take that into account. But the type approval test just covers one particular situation. This fact is accepted by all technical services. The expert from OICA pointed out that the J justification seems attached to the stationary target detection on secondary roads; he suggested to consider the secondary road conditions in the frame of the stationary target situation.

CLEPA reminded about their proposal for a 2<sup>nd</sup> test to assess the false failure rate; hence to test the quality of the system. While the CLEPA expert recognized that the J proposal for two test speeds seems to address the same target, he was of the opinion that different test speeds will give no indication about the quality of the system.

NL was of the opinion that one high speed test seems sufficient, with one requirement, i.e. no collision. He welcomed the idea of CLEPA about the false alert test.

PL supported subject vehicle initial speed of 80 km/h, one test only.

ROK had a neutral position.

The Chair summarized the situation by indicating that four Contracting Parties believe that one test is sufficient, supported by OICA and CLEPA. The reasons from J and UK to request two test speeds are different. As there was no clear indication that the parties want to change their position, the Chair feared to have to report to GRRF that no solution within the informal group is likely to be found on this item. But the group was reluctant to make the decision being taken by “another forum”. As time was lacking to continue the discussion at this meeting, the Chair recommended the parties to re-consider their positions.

Conclusion: item to be re-discussed at the 6<sup>th</sup> meeting of the informal group.

#### Initial distance between subject and target

Conclusion: J agreed to keep the current text of the skeleton paper

#### Vehicle centreline offset

J considered questioned the necessity of such requirement.

CLEPA: a provision is needed to avoid claims from either the manufacturer's or the Technical Services' sides.

The representative of the NL informed that in practice, the offset is not measured with accuracy. The test is performed such that there is confidence that the provision is respected. J reluctantly changed their position and agreed on a mandatory offset below 0,5 m

Conclusion: offset < 0,5m adopted

#### Criteria

UK: committed to review their position internally.

J: presented document AEBS/LDWS-05-08. The expert recognized that collision avoidance is ideal, but stressed that other parameters must be taken into account, as the detection of stationary obstacles makes the false alerts more likely. The expert also stressed the need to take into account the experience in all markets and from all manufacturers in addition to the current available technology.

As it can be assumed that the traffic situation and the driver's responses are similar in Japan and in the EU, the Chair wondered whether the difference in approach between the performance levels of the system in Japan (collision mitigation) vs. in EU (collision avoidance) is based on different technological choices.

CLEPA informed that their experience in AEBS includes passenger cars as well as heavy vehicles.

PL supported a collision avoidance scenario.

Pass/fail criterion speed reduction (warning phase inclusive)

Japan informed about their wish to compromise about the acceptable speed reduction based on a target vehicle speed of 15 km/h. The expert however made clear that 70 km/h speed reduction is considered not feasible and committed to confirm a value at the 6<sup>th</sup> meeting of the informal group. He stressed that collision avoidance can not be considered safer than collision mitigation when all side-effects (false braking activation, driver acceptance) are taken into account.

OICA confirmed that no common position could be found to date on this item. The expert clarified that this lack of position implies that OICA cannot support any of the positions currently on the table.

PL found appropriate to use the collision avoidance as the pass/fail criterion.

CLEPA requested a deceleration above 5 m/s<sup>2</sup> or "full brake capabilities" as pass/fail criterion. CLEPA would reluctantly accept two criteria i.e. two system performances if there is no agreement on a single criterion.

NL was reluctant to that approach: the principle of the regulation is to have one package of requirements.

D, UK, NL, F confirmed their position as in document AEBS/LDWS-04-08.

OICA called up the Contracting Parties about their acceptability of the "no collision" criterion with a low relative speed.

The Chair reminded that the aim is to avoid destructive test and to assess good performance of the system.

Latest warning time before Emergency braking phase (refers to current definition i.e. includes 4.0 m/s<sup>2</sup> criterion)

Japan presented document AEBS/LDWS-05-04.

The Chair raised some apparent contradiction between the reaction time values specified in the WP29-ITS guidelines (document ITS-18-04) and those presented in the Japanese document AEBS/LDWS-05-04 for the case of drivers not expecting a hazard: the ITS guidelines refer to an estimated brake reaction time of 1.15 s (for common hazards such as brake lights) to 1.4 s (for complete surprise events) while the Japanese presentation refer to an average reaction time of 0.75 s for all situations. The expert from Japan committed to investigate this apparent contradiction.

OICA confirmed to work on a common position

UK confirmed the position as set out in document AEBS/LDWS-04-08.

CLEPA was keen to add a maximum time (2.5 s) before which the system should not warn the driver. The expert recognized that a delay of only 0,5 s (between 2,5 s and 2,0 s) is quite narrow, but justified the addition of a maximum time limit by the necessity to build driver's confidence.

NL confirmed their position. The expert explained that the warning phase is very important as it is the time to be used to awake the driver. The expert could not imagine this time to be below 1,0 s because this is already the limit for an awoken driver. For drowsy drivers, the delay should be longer. As the regulation must prescribe the latest time for the warning NL proposed [1,4s] as a compromise between 0,8 and 2 s.

France was of the opinion that the latest warning time should correspond to the minimum reaction time provided by the surveys (J, ITS), then increased the time to take into account the drowsiness of the driver. The expert found that the warning time should not be more than 2 s before brake application.

Japan was keen to differentiate the performance requirements for M3 and N3 vehicles. There was the concern that the coach passengers in Japan do not wear safety belts, making high braking dangerous. The expert from Japan was keen to get data about accident data of coaches in EU: truck vs. coach drivers may have different behaviour. It was however noted that when there is no braking, the effect for the passengers becomes even worse.

## PHASE 2: STATIONARY TARGET SCENARIO

### Subject vehicle initial speed :

CLEPA pointed out that testing the vehicle in the stationary target scenario at speed different to that required for the moving target scenario permits to test the vehicle at two speeds and to preserve the target.

OICA confirmed their position, remaining open to discuss the initial vehicle speed.

D supported one test only at an initial speed of 80 km/h

UK informed that a firm position will be given at the 6<sup>th</sup> meeting of the informal group in June.

NL considered the high speed as the worst case, but was ready to decrease the initial speed for preserving the target, with no indication about the level.

ROK had no position

### Initial distance between subject and target

Conclusion: J agreed to keep the current text of the skeleton paper

### Vehicle centreline offset

Conclusion: J agreed to keep the current text of the skeleton paper



## Criteria

D was ready to follow the decision of the informal group.

UK informed that a firm position will be given at the 6<sup>th</sup> meeting of the informal group in June.

The experts debated on the technical feasibility of performing a test at an initial speed of 40 km/h with no collision to the target.

CLEPA and J found the parameters quite challenging. CLEPA demonstrated via the Excell file AEBS/LDWS-04-10 that some stationary target scenario can already be met. J showed videos of tests performed in J where the target is damaged and sometimes destroyed. The Chair recalled from the video footage shown that the vehicle after hitting the stationary target apparently does no longer decelerate, which raises the question whether the performance requirements for the stationary target scenario should address the need for post-crash braking.

ROK had no position

A debate took place about the definition of the target:

- A balloon bearing reflexion components representing a passenger car
- UK keen that the definition of the target is accurate as it is needed at the time of Conformity of Production (COP)
- Need to further discuss the principle and the wording. Possible consensus following the CLEPA approach

Latest warning time before Emergency braking phase (refers to current definition i.e. includes 4.0 m/s<sup>2</sup> criterion)

D founds too early to discuss the stationary target scenario.

ROK had no position

## FURTHER TEST SCENARIO

Document: AEBS/LDWS-04-11 (CLEPA) Overtaking manoeuvre test (false warning test)  
The group started a debate about the need to elaborate a further test scenario. CLEPA justified the choice for the “overtaking test” among the others proposed in document AEBS/LDWS-TF-02-03 as the overtaking situation occurs more often than the others.

OICA: found such proposal going beyond the regulatory exercise. ESC for example has no false application test because it is not necessary in an homologation regulation. The expert reminded that the false warning cannot be considered as a dangerous situation (the expert referred to the LDWS frequent false warnings) while the false brake application are, yet they are already covered by the “CEL annexes” (Annex 18 in UNECE R18). CEL annex addresses the internal interactions of the electronic systems with the safety relevant systems of the vehicle and, as the ESC sensors give external information to the system, the AEBS radar does. Hence the CEL annex fully covers the AEBS situation.

UK found false activation a concern, so supported a test addressing that. However UK also supports an approach with documentation supplementing the test.

D found unnecessary to perform more than one test.

NL favoured an extra test to assess false braking. The expert however was of the opinion that false alerts will be automatically regulated by customer complaints.

#### AEBS/LDWS-05-02

The group discussed the above document:

- CLEPA found 15 km/h inaccuracy quite inaccurate for an Adaptive Cruise Control (ACC)
- OICA pointed out that the J calculation is valid for the case of a one-shot speed measurement. But the expert explained that the AEBS in real world situation has the capability of calculating the target speed with better accuracy thanks to a continuous speed measurement.

Conclusion: J committed to review the document in light of the comments received.

#### AEBS-LDW-05-03

J agrees to keep the current text of the skeleton paper.

#### AEBS-LDW-05-05

The group had a debate about the relevant provisions to introduce in the draft regulation for addressing Periodic Technical Inspection (PTI)

The experts were of the opinion that, as AEBS is not a system subject to wear, there is no need to introduce special provisions for PTI.

### WARNING STRATEGY

The group evaluated the pros and cons of inspire the AEBS warning strategy from the LDWS case.

UK supported an approach based on the LDWS warning strategy. The expert was keen to have no confusion between AEBS and other systems.

Conclusion: OICA volunteered to propose a full warning strategy for the 6<sup>th</sup> meeting (June 2010) based on the LDWS decision.

#### *6.1.2. Performance requirements*

AEBS/LDW-02-02-Rev.1 (§ 5.2)

AEBS-LDW-04-06 - (Japan) AEBS new proposal for reference point

AEBS-LDW-04-11 - (CLEPA) Proposed amendments to AEBS “skeleton” document for a reduced number of type approval warning and brake application tests

See item 6.1.1.above

### 6.1.3. *Warning requirements*

AEBS/LDW-02-02-Rev.1 (§ 5.5)

AEBS-LDW-04-11 - (CLEPA) Proposed amendments to AEBS “skeleton” document for a reduced number of type approval warning and brake application tests

See item 6.1.1.above

## **6.2. skeleton paper: review and update**

Document: AEBS/LDW-02-02 -Rev.1 - Updated AEBS skeleton paper after 3<sup>rd</sup> meeting of the informal group (Secretariat)

Due to the lengthy discussions on the performance criteria and the outstanding issues still to be resolved, the informal group could not yet proceed with the review and update of the AEBS skeleton paper. Agenda item to be carried over to the next meeting in June.

## **7. Other business**

Japan announced their wish to investigate the driver over-reliance issue at the 7<sup>th</sup> meeting of the informal group.

## **8. List of action items and issues for the next IG meeting in June 2010**

The Chair recalled from the discussions the following main action points for the next meeting:

- Japan to review the data relating to the driver reaction time, in view of the differences in values referred to in the ITS Guidelines
- OICA volunteered to prepare for further discussion, a draft proposal for the AEBS warning strategy, based on the agreement the informal group reached on the warning strategy for LDWS.
- All Contracting Parties and industry associations are urged to carefully consider and re-assess their position on those AEBS performance criteria for which divergence of opinions continues to exist. All parties are invited to show some flexibility at the next meeting with a view to achieve consensus on these issues within the informal group on AEBS/LDWS. This to avoid that too many and important issues will remain outstanding for which guidance or even resolution would have to be sought from GRRF.

## **9. Schedule for further meetings.**

Document: AEBS-LDW-03-02-Rev.1 - (Secretariat) Schedule of meetings after IG04

Due to the fact that the WP.29 informal group on the review of the 1958 Agreement will meet in Paris on the 18<sup>th</sup> of June, the next meeting of the informal group on AEBS/LDWS, which was originally scheduled for the 17<sup>th</sup> + 18<sup>th</sup> of June, will be advanced with one day, starting on the 16<sup>th</sup> of June 2010.