Report of

2nd Meeting of the Informal Working Group

on

Quiet Road Transport Vehicles for a Global Technical Regulation

December 5th to 7th 2012,

held at the VDA, Berlin, Germany

1. Introduction of participants and organizations

National bodies: Canada (Transport Canada), Spain (LCOE), EU Commission, UK (DfT), Korea (Korea Transportation Safety Authority), US (NHTSA, Chairman), Germany (BMVBS), Japan (NTSEL & JASIC).

Associations: DBSV (German Federation of the Blind and partially sighted), NFB (US National Federation of the Blind), WBU (World Blind Union), OICA ((Renault, MAN, Porsche AG, Daimler AG, Scania, Volvo Trucks, Ford), ISO, CLEPA (Denso, Brigade Electronics), IMMA.

Universities: Nagasaki University, TU Dresden

2. Adoption of the agenda

The agenda was adapted to the latest status

3. Adoption of the minutes of 1st meeting

The minutes were reviewed and adopted without changes

4. Update on latest development in the regions

The chairman informed the group that the NPRM was not yet published owing to the elections in the US. It will be released within the next months. (*rem.: the NPRM is published in the meanwhile*)

5. Presentation ' ISO/SAE Status Report: Quiet Car'; ISO (Doug Moore)

This presentation is intended to illustrate the differences between both the proposed VOLPE/NHTSA test method and the current ISO 16254/SAE J2889-1 in terms of vehicle test conditions, measurements and information metrics, indoor and component testing and pitch shifting. For this purpose, 4 work packages for data collection were developed:

1: Measurement of vehicles at the conditions outlined by NHTSA/Volpe in the published research report. Measurements include both Indoor and Outdoor evaluations. Data collected to date: Background noise evaluations, vehicle measurements

2: Measurement of interior sound (recordings and analysis), Evaluation of transmission loss. Data collected to date: Recordings available, Transmission Loss evaluated.

3: Correlation of detection and recognition to proposed levels. Data collected to date: Jury evaluations of detection and recognition

4: Measurement of frequency shifting at conditions outlined in NHTSA/VOLPE research report. Data collected to date: Indoor and outdoor evaluations

Conclusions:

The use of 1/3 octaves for the sole performance specification as proposed in the NHTSA/VOLPE research paper will require changes to the ISO/SAE test procedures to provide for the sound being measured to be available for a time of approximately 30 seconds. Correction of 1/3 octaves with background noise levels is not possible due to variation.

The test methods proved to be sensible against background noise so that indoor testing appears more promising in view of repeatable and reproducible results. This avoids the necessity for outdoor test facilities in extremely low noise areas as '2m' indoor-facilities with cut off frequencies below 200Hz are widely available.

Canada was not aware of any indoor facilities available, **Spain** mentioned that there is no standard available for the certification of indoor labs, **OICA** replied that indoor facilities are used today for horn (ECE R28) certification and that many anechoic test benches exist that would satisfy the necessary cut-off frequency for testing. In addition ISO is working on a standard for indoor type approval for the purpose of pass-by noise certification. **Japan** knows about suitable test facilities, which however are barely available for governments. **ISO** informed that most OEMs had indoor

facilities available and that the ISO/SAE procedure was written so to be applied in- and outdoor.

Measurement of pitch shift will need to be accomplished at a component level, or on a vehicle in such a manner as to simulate a component test, and utilizing narrowband analysis for technically correct measurements. Knowledge of the signal used is required for correct testing.

6. Presentation 'Status Report: Quiet Car'; OICA (HM Gerhard)

OICA is working on the same work packages as ISO. Up to today packages 1 and 2 have been investigated.

97 vehicles within the OICA database were analysed. Although all these vehicles don't pose a concern in today's traffic, meaning they are sufficiently recognisable by pedestrians, almost none of them fulfil the VOLPE requirements. Even sport cars that might be seen as obviously loud don't satisfy the combinations of 3rd octave bands & SPLs as proposed. Therefore the proposal is to either reduce the number of minimum required 3rd octave bands but keep the VOLPE proposed SPL levels or to keep the proposed 3rd octave bands, however with reduced SPLs. It is also thinkable to prescribe a certain acoustic energy content that must be emitted with at least 2 of the proposed bands, but can also be distributed amongst more than 2.

The typical vehicle speed when driving in town is between 0kph and 30kph, so that AVAS would be active most of the time. This comprises the risk of driver and passenger annoyance from frequencies transmitting into the vehicle. The transmission loss between outside and inside of the vehicle decreases typically with 6dB per octave with frequencies becoming lower, so that low frequency content is difficult to be attenuated and can only be realised by adding mass in form of insulation material. Below 400Hz it is almost impossible to depressed sound to a level that will not be audible for vehicle passengers.

EVs are designed under specific light weight aspects so to enable longer driving ranges. Additional insulation material necessary to reduce noises from AVAS penetrating into the passenger compartment would jeopardize these design strategies. To overcome this, it is essential to restrict AVAS sounds to a level in SPL as well as to octave bands that are acceptable for the driver and the passengers to avoid distraction, annoyance and rejection.

7. Presentation DBSV; (H. Kaltwasser)

After an overview about the activities of the DBSV (Deutscher Blinden- und Sehbehinderten Verband = German Association of the blind and partially sighted), the specific impacts of silent cars on independent travelling and the associated risk scenarios were presented.

In order to facilitate blind people's right to be out in the streets and move around independently, all legislative work should take into account that this right is a human right enshrined in the Convention of Rights of Disabled People. The CRDP was adopted by the United Nations General Assembly in 2007 and has been ratified by many state parties in the world.

The DBSV therefore proposes the following actions and measures to be taken so to ensure the safety of blind and partially sighted citizens:

- The AVAS system should be installed on all low sound level vehicles
- The installation of the AVAS system should be mandatory
- The sound produced by the AVAS system should be generated automatically at speeds of up to 30 km/h.
- No On/off switch
- Clear and easy indication of all modes of operation
- Avoid natural and alarm sounds
- Automatic operation

These requirements are explicitly supported by the **NFB**. **OICA** raised the question in how far existing problems with trolley buses, trams etc. are handled today. **NFB** replied that the danger arising from rail-bound means of transport clearly is lower.
OICA pointed out that if the sound differs as a function of vehicle classes with lower frequencies being mandatory for big vehicles, this risks being in conflict with environmental requirements due to bigger energy content of low frequencies.
UK asked for the need of sounds differing between forward and backward movement. This requirement is in conflict with UK national law which prohibits a backup alarm on private vehicles. For the **NFB**, a special backward sound would allow to prepare for a change in driving direction.

8. Presentation ' A study of AVAS on the QRTV'; (KATRI, Jinwoo Park)

This presentation compares the currently available test methods and boundary conditions with traffic situations typically occurring in Korea. From the findings, it is concluded that

- The test method should comprise a component under acceleration in addition to standstill and cruise-by (SAE J2889-1)
- The necessary sound level of AVAS is 55~60dB(A) in cruise and 60~65dB(A) in acceleration. The proposed value for acceleration is considered as minimum.
- The AVAS should be active up to a velocity of 25km/h
- Frequency shift measurement also can be conducted outdoor

Comments

ISO/SAE haven considered the inclusion of acceleration and outdoor-testing. Eventually this idea was dropped due to the poor repeatability.

9. Presentation 'Reaction of pedestrians to various vehicle exterior noises' (TU Dresden, Ercan Altinsoy)

This presentation reports about the findings from an extensive research on the evaluation of characteristics of acoustical signals in the surrounding of typical urban traffic situations. The research also determines the most important attributes to ensure their safe detectability of acoustic signal to be produced by AVAS.

The main conclusions drawn from the research are as follows

- Individual one-third-octave bands (low or high frequencies) being prominent ensure the detection of vehicles from ambient conditions.
- Relatively few signal elements are used to detect the sound of internal combustion engine vehicles.
- Low-frequency engine orders play an important role on the detection.
- Essential parameters:
  - Tonality
  - Time variance (e.g. Modulation, impulsiveness etc.)
  - Spectrum outside of the ambient

10. Presentation 'QRTV France – Positions and Proposals'

The representative from France was prevented to participate the meeting. Therefore the presentation was only read out by the secretary.

The basic requirements from France are as follows:

- Fitment of AVAS shall be mandatory
- Requirements shall be based on RE3
- The level of sound shall be levelled to be sufficiently detectable but not excessive.

  It is of high important for France to make AVAS acceptable in public so that as few opposition as possible will occur.
- Scope for AVAS EV & HEV
- Sound shall fade out between 20kph and [40kph]
- A qualification test derived from ISO 16254 shall detect applicability for individual vehicle types.

  At this point the Chairman mentioned the possibility of a vehicle emitting noise with a level that would exclude this vehicle type from falling into the QRTV requirements. However the emitted noise might be not suitable to protect pedestrians

- No sound at idle as this risks to be annoying
- A minimum and a maximum sound level needs to be determined
  Minimum sound level of modern ICE however may be too low to give a good reference level

11. Presentation 'Concept of QRTV GTR based on RE3', (Dr. Sakamoto, JASIC)

Japan presented its concept for a GTR that is based on the requirements from RE3. There should be no sound when vehicle is stopped as these risks masking sounds from other (slowly moving) vehicles. This is not a concern of EV/HEV, but may also occur with ICEV. However, the risk of masking from AVAS is higher than from ICE.

NFB prefers to have sound on in standstill; this should be the case for ICEV equipped with Start/Stop systems as well. Blind people can distinguish between different sounds. Therefore the greater risk is when vehicles are not detectable at all. Brigade proposes to attenuate sound in standstill condition. EV/HEV could be fitted with a sensor that detects vehicles in front. In this case, AVAS can be turned off. A pause switch is possible, but must not be at the driver's discretion. For the deactivation intelligence is needed to detect that AVAS is obviously not necessary, e.g. on a motorway.

For **COM**, a start-up sound is enough to ensure pedestrian safety. The SPL of AVAS is crucial and should be adapted to ambient noise.

OICA: This however is technically difficult to realise as in practise it is critical to distinguish real ambient noises from noises produced by AVAS. The necessary intelligence could come from pedestrian recognition systems allowing the AVAS to be turned off when not pedestrian is in the proximity.

On pitch-shifting, **Canada** prefers a clear requirement instead of the mentioned manufacturer's report. For OICA an objective test is possible only if in addition component testing is allowed.

For various reasons there is general acceptance that a threshold SPL needs to be defined: EVs/HEVs which emit a certain level of noise and are detectable without AVAS should be excluded form requirements. Also public acceptance implies the avoidance of additional noise sources.

12. Presentation 'EU proposed approach of QRTV GTR' (Nickolas Kakizis, EU COM)

The presentation is on policy rather than on technical level. EU COM sets out its main prerequisites and boundary conditions.

The new GTR needs to

- be flexible, simple and provide "one solution to fit all" with suitable provisions for future technological and scientific developments.
- be innovation-friendly and not create market or trade constrictions.
- be "ready for adoption" or “attractive for adoption” by the contracting parties
- take into consideration that EVs and HEVs are expected to grow exponentially in numbers over the next few years (cumulative effect, noise exposure levels, and disorientation effects in heavy traffic conditions).

13. Next meeting

The next meeting is scheduled to take place from April 16 to 18 in Europe, Brussels/Belgium.