ECE/TRANS/XXX

01 July 2013

GLOBAL REGISTRY

Created on 24 May 2013, pursuant to Article 6 of the
AGREEMENT CONCERNING THE ESTABLISHING OF GLOBAL TECHNICAL REGULATIONS FOR WHEELED VEHICLES, EQUIPMENT AND PARTS WHICH CAN BE FITTED AND/OR BE USED ON WHEELED VEHICLES
(ECE/TRANS/132 and Corr.1)
Done at Geneva on 25 June 1998

Addendum

Global technical regulation No. YYY

TECHNICAL REQUIREMENTS *REGARDING*
AUDIBLE VEHICLE ALERTING SYSTEMS FOR QUIET ROAD TRANSPORT VEHICLES

(Established in the Global Registry on DD.MM.YYYY)

UNITED NATIONS

As requested by the 3rd GTR QRTV Informal Working Group, the text below was prepared by OICA, as a compilation of specification on sound devices for the purpose of informing pedestrians about the presence of a vehicle. The table shows the documents used for the development of this text. The colours indicate in origin.

Source	**Colour**
Minimum Sound Requirements for Hybrid and Electric Vehicles NHTSA 49 CFR Part 571 Docket No. NHTSA-2011-0148 RIN 2127-AK93	**Bold Black**
Guideline on Low-noise Measures for HEV, etc Japan Guideline Kokujigi No. 255 on 2010-01-29	Red
Japan Study Committee Report on Low Noise Measures for Hybrid Vehicles, etc	*Red Italic*
Proposal for guidelines on measures ensuring the audibility of hybrid and electric vehicles UN-ECE R.E.3 Annex 2 Guideline AVAS	Green
Draft Recommendations for a Global Technical Regulation Regarding Audible Vehicle Alerting Systems for Quiet Road Transport Vehicles GRB Informal Group Report ECE-TRANS-WP29-GRB-55-inf14e	*Green Italic*
Other Sources (EU 2011_0409 (COD) with amendments of Parliament A7-0435_2012 and Council st05832.en13[1] PUBLIC)	Blue
OICA comments to US NPRM NHTSA-2011-0148	Pink
OICA additional comments	***Pink Italic***

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A. JUSTIFICATION AND TECHNICAL RATIONALE

1. INTRODUCTION

This global technical regulation (gtr) is setting minimum sound requirements for hybrid and electric vehicles. This new standard would require hybrid and electric passenger cars, light trucks and vans (LTVs), medium and heavy duty, trucks, and buses, low speed vehicles (LSVs), and motorcycles to produce sounds meeting the requirements of this standard. This proposed standard applies to electric vehicles (EVs) and to those hybrid vehicles (HVs) that are capable of propulsion in any forward or reverse gear without the vehicle's internal combustion engine (ICE) operating. This standard would ensure that blind, visually-impaired, and other pedestrians are able to detect and recognize nearby hybrid and electric vehicles, as required by the PSEA, by requiring that hybrid and electric vehicles emit sound that pedestrians would be able to hear in a range of ambient environments and contain acoustic signal content that pedestrians will recognize as being emitted from a vehicle.

Following a decision to promote their widespread use toward the low-carbon society, registrations of hybrid vehicles (HEV) and electric vehicles (EV), etc have been rapidly growing in recent years with even further growth projected in years to come.
In the meantime, users and groups for the visually-impaired have expressed views that they find those vehicles dangerous due to the mechanism that does not make high noise, while similar points are made by some experts.
Therefore, in order to promote effective measures relating to the low noise as reported by the Study Committee on Low Noise Measures for Hybrid Vehicles, etc, requirements have been established as described below for those Devices for Approaching Vehicle Alert to be installed in HEV that can run only on electric motors with the internal combustion engines in shutdown condition, EV and fuel-cell vehicles.

It shall be assessed the need to review this Regulation, taking into account, inter alia, whether active safety systems can better serve the objective of improving the safety of vulnerable road users in urban areas, in addition to, or as compared to acoustic vehicle alerting systems and shall, where appropriate, and in accordance with the ordinary legislative procedure, submit a proposal which makes provision for a maximum sound level for AVAS installed in vehicles.

The environmental benefits achieved by hybrid electric and pure electric road transport vehicles (HEV and EV) include near zero air pollution, reduced fossil fuel demands and very quiet vehicle operation at low speeds. While quiet vehicle operation provides the potential for significant public health and welfare benefits to millions of citizens, it has resulted in an unintended consequence - the removal of an important source of audible signals that are used by many pedestrians (e.g. blind, low vision and elderly pedestrians) and road users (e.g. cyclists), to signal the approach, presence and departure of these vehicles.
This report presents the findings and recommendations of the QRTV / IWG with regard to the future development of a globally harmonized regulation that would specify the applicability and performance of an 'Audible Vehicle Alerting System' (AVAS). The AVAS would provide pedestrians and other road users with information regarding the operation of quiet vehicles at speeds below 20 to 30 kilometres per hour (12 to 20 miles per hour) that is essential to safe

movement decisions while also protecting the public from unnecessary increases in environmental noise and the vehicle operator from adverse noise impact.
Particular attention should be given to those countries that have programs directed at the reduction of community noise impact. While an in-depth assessment of the potential growth of the quiet vehicle fleet was beyond the scope of the QRTV terms of reference, there is substantial evidence to support a conclusion that any resulting UN/ECE regulation regarding AVAS must be harmonized as a Global Technical Regulation (GTR) to reduce pedestrian confusion and to minimize diverse regulatory burdens on powered road vehicle manufacturers.

2. PROCEDURAL BACKGROUND

During the one-hundred-and-fifty-sixth session of WP.29 on March 2012, the Executive Committee (AC.3) of the 1998 Global Agreement (1998 Agreement) adopted a two stage approach for developing the UN GTR, including in a first phase electric and hybrid vehicles and, in a second phase, quiet vehicle with internal combustion engines and possible inclusion of safety related matters.

Informal working groups – the GRB Informal Group on Quiet Road Transport Vehicles (QRTV) from March 2009 to September 2012 and the GRB GTR development group on QRTV from March 2012 to XXX – were established develop a proposal for this GTR.

The working group was instructed to

- Identify, review and assess the status of various researches being carried out by various governments, universities and non-governmental organizations on audible warning and signalling technologies for quiet vehicles.
- Invite, consult with and consider the input of safety experts from GRSP, GRRF, and GRSG.
- Determine potential audible sound characteristics and mechanisms that convey desired vehicle performance information to the human receiver.
- Develop harmonized test procedures for evaluating the conformity of potential audible sound characteristics and mechanisms.
- Determine the costs and benefits associated with a QRTV gtr including potential adverse impact on the public at large or existing vehicle noise emission standards and regulations. Note that the analysis is not intended to address specific countries or regions, but rather general considerations each Contracting Party (to WP.29) should consider when implementing the potential gtr.

US and Japan may wish to add some elements of their national studies.

3. EXISTING REGULATIONS, DIRECTIVES, AND INTERNATIONAL VOLUNTARY STANDARDS

3.1. Those pertaining to minimum sound requirements for motorized road vehicles

In the United States of America:

49 CFR Part 571, Docket No. NHTSA-2011-0148, RIN 2127-AK93, Federal Motor Vehicle Safety Standards, Minimum Sound Requirements for Hybrid and Electric Vehicles

In Europe:

Draft Regulation 2011/0409 (COD) with amendments of the European Parliament listed in A7-0435_2012 and changes by the European Council published in st05832.en13[1] PUBLIC and subsequent amendments.

In Japan:

Guideline on Low-noise Measures for HEV, etc
To be updated

In China:
To be updated

4. TECHNICAL RATIONALE, ECONOMIC IMPACTS, AND ANTICIPATED BENEFITS

4.1. Technical rationale

The requirements of this proposal apply only to those HVs that are capable of propulsion in any forward or reverse gear without the vehicle's ICE operating because these were the vehicles that the agency believes fall under the definition of "hybrid vehicle" contained in the PSEA. A crossover speed of 30 km/h was chosen because this was the speed at which the sound levels of the hybrid and electric vehicles measured by the agency approximated the sound levels produced by similar ICE vehicles. This proposal contains minimum sound requirements for the activated but stationary operating condition because the definition of alert sound in the PSEA, as explained in Section III of this NPRM, requires the agency to issue minimum sound requirements to allow pedestrians to detect hybrid and electric vehicles. We have tentatively determined that this requirement can be best met by requiring vehicles to emit sound in this operating condition.

At lower speeds, hybrid and electric vehicles produce less sound than vehicles propelled by an ICE. At higher speeds, tire and wind noise are the main contributors to vehicles noise output so at higher speeds the sounds produced by hybrid and electric vehicles and ICE vehicles are similar. Because hybrid and electric vehicles do not produce as much sound as ICE vehicles when operating at lower speeds, pedestrians and other road users may not be aware of the presence of a nearby hybrid or electric vehicle. If a hybrid vehicle is involved in a low speed maneuver (defined as making a turn, slowing or stopping, backing up, entering or leaving a parking space, or starting in traffic), it is 1.38 times more likely than an ICE vehicle to be involved in a collision with a pedestrian and 1.33 times more likely to be involved in a collision with a pedalcyclist. We believe that this difference in accident

rates is mostly attributable to the pedestrians' inability to detect these vehicles by hearing them during these maneuvers.

Discussions were held from the perspectives described below concerning (i) EV run※-enabled HEV and EV (including fuel-cell vehicles), (ii) non-EV run HEV, (iii) vehicles with idle stop engines and (iv) ordinary vehicles with engines making low noise, for which measures may be needed.

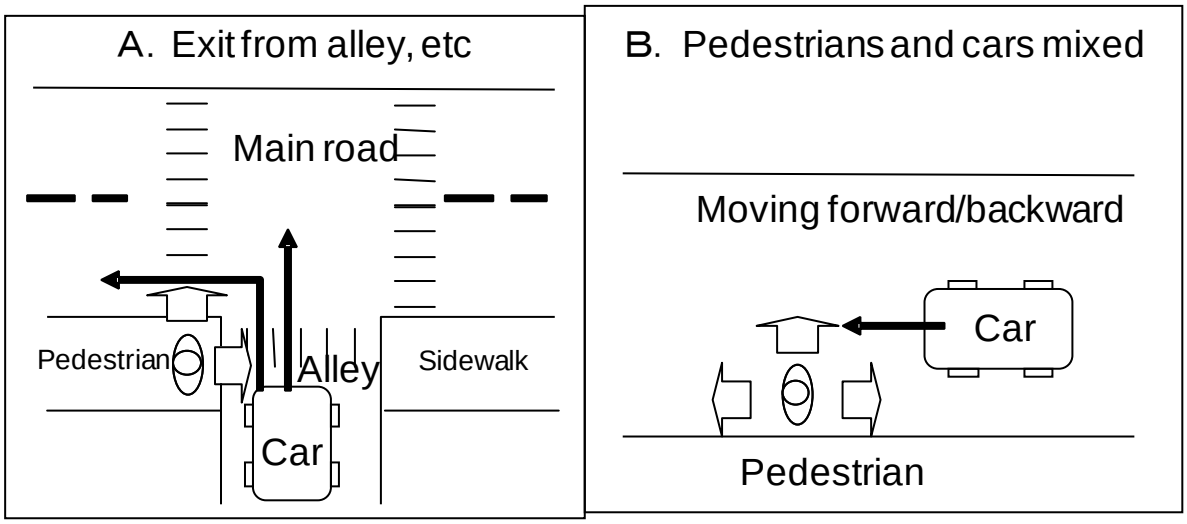
・(i): It has been reported that difference in sound volume from vehicles reaches 20dB at maximum compared with ordinary vehicles with engines from starting to vehicle speed of about 20km/h; hence, measures are required. (See Diagram C.)

・(ii): With engines always fired up during starting, it was confirmed at the Study Committee's experience session that these vehicles are equally noticeable compared with ordinary vehicles with engines; hence, measures are not needed.

・(iii): As with the above (ii), with engines always fired up during starting, these vehicles are considered equally noticeable compared with ordinary vehicles with engines; hence, measures are not needed.

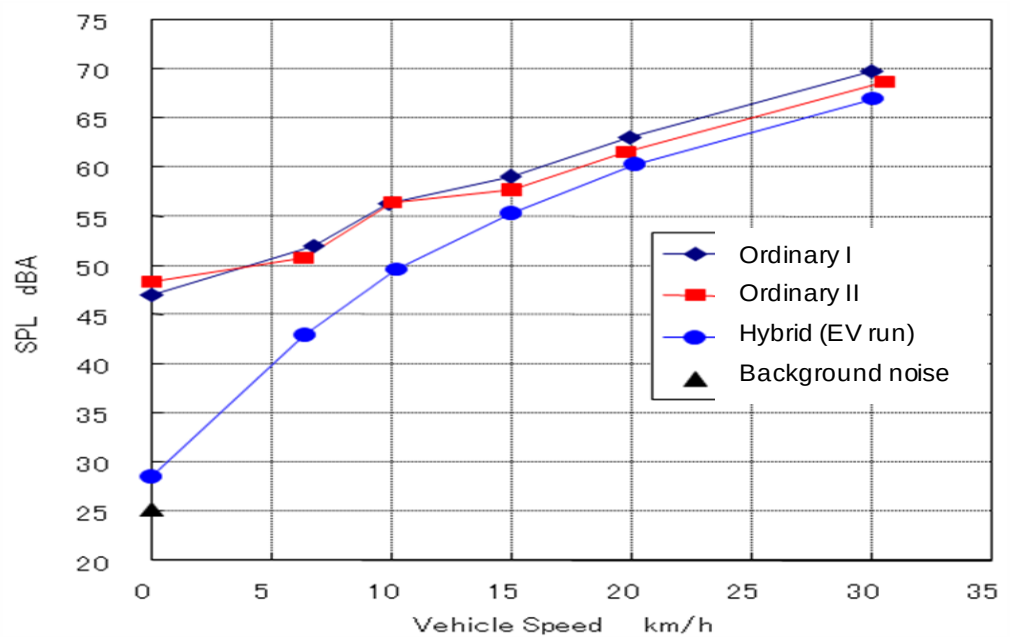
・(iv): As a result of comparison between luxury models with quiet engines and ordinary models in the surveys conducted so far, the gap is not huge at about 2dB; hence, measures are not needed. (See Diagram C.)

2. Scenes in which measures are required
Proposed measure:
Applicable in a range from starting to vehicle speed of 20km/h and when moving backward.
[Concept]
Based on the experience by the visually-impaired, etc, low noise measures are most needed when a vehicle is starting from a stopped state (Diagram A) and when it is running at low speed (Diagram B), in which case it will be required to notify approaching vehicles to pedestrians, etc, including the visually-impaired.



・The surveys conducted so far revealed that, since tire noise increases under the vehicle speed of 20km/h, even EV run-capable HEV is equally noticeable compared with ordinary vehicles with engines. (See Diagram C.)

Diagram C:
Comparison of sound volume (Microphone was placed at 2 meters to the left form the centerline of running vehicles and 1.2 meters from the ground. When stopped, it was place at a position immediately next to the front edge of vehicles.): EV run-capable HEV vs. ordinary vehicles with engines



Japan may wish to update this chart

Some are calling for measures even when a vehicle is stopped; however, since it is the same state as ordinary vehicles with engines parked or stopped with engines off, specific measures for hybrid vehicles, etc are not needed.

4.2. Economic impacts

To be added (test time, money, employees)

4.3. Anticipated benefits

To be added

5. ADMINISTRATIVE CONSIDERATIONS

To be added; Considerations about: Vehicle testing, component testing; other ways for pedestrian protection in terms of quiet vehicles

6. POSSIBLE FUTURE EXTENSIONS OF THE GTR

The need to review this Regulation shall be assessed, taking into account, inter alia, whether active safety systems can better serve the objective of improving the safety of vulnerable road users in urban areas, in addition to, or as compared to acoustic vehicle alerting systems.

B. TEXT OF REGULATION

1. PURPOSE

The purpose of this standard is to reduce the number of deaths and injuries that result from electric and hybrid vehicles crashes with pedestrians by providing a sound level and sound characteristics necessary for these vehicles to be detected and recognized by pedestrians.

2. SCOPE

This standard establishes performance for pedestrian alert sounds from motor vehicles.

This standard applies to Electric vehicle passenger cars, multipurpose passenger vehicles, trucks, buses, motorcycles, and low-speed vehicles; Passenger cars, multi-purpose passenger vehicles, trucks, buses, and low-speed vehicles with more than one means of propulsion for which the vehicle's propulsion system can propel the vehicle in the normal travel mode in reverse and at least one forward drive gear without the internal combustion engine operating and; Motorcycles with more than one means of propulsion for which the vehicle's propulsion system can propel the vehicle in the normal travel mode in at least one forward drive gear without the internal combustion engine operating.

3.1. **Small volume manufacturers.** *(May need to be adapted to UN-ECE specs)*

3.1.1. **Vehicles manufactured during any of the three years of the September 1, 2015 through August 31, 2018 phase-in by a manufacturer that produces fewer than 5,000 vehicles for sale in the United States during that year are not subject to the requirements of S9.1, S9.2,S9.3 and S9.5.**

3.1.2. **Final-stage manufacturers and alterers. Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with Part 567 of this chapter are not subject to the requirements of S9.1 through S9.5. Instead, all vehicles produced by these manufacturers on or after September 1, 2018 must comply with this standard.**

3.2. *Discussions were held from the perspectives described below concerning (i) EV run※-enabled HEV and EV (including fuel-cell vehicles), (ii) non-EV run HEV, (iii)*

※ *EV run refers to run on the electric motor only with the engine stopped.*

vehicles with idle stop engines and (iv) ordinary vehicles with engines making low noise, for which measures may be needed.

(i): It has been reported that difference in sound volume from vehicles reaches 20dB at maximum compared with ordinary vehicles with engines from starting to vehicle speed of about 20km/h; hence, measures are required. (See Diagram C.)

(ii): With engines always fired up during starting, it was confirmed at the Study Committee's experience session that these vehicles are equally noticeable compared with ordinary vehicles with engines; hence, measures are not needed.

(iii): As with the above (ii), with engines always fired up during starting, these vehicles are considered equally noticeable compared with ordinary vehicles with engines; hence, measures are not needed.

(iv): As a result of comparison between luxury models with quiet engines and ordinary models in the surveys conducted so far, the gap is not huge at about 2dB; hence, measures are not needed. (See Diagram C.)

3.3. ***This guideline addresses Acoustic Vehicle Alerting System (AVAS) for hybrid electric and pure electric road transport vehicles (HEV and EV).***

3.4. **"Acoustic Vehicle Alerting System" (AVAS) are means systems for hybrid electric and electric road transport vehicles which provide vehicle operation information sound to signal the vehicle's presence to pedestrians and vulnerable other road users.**

4. DEFINITIONS

4.1. **"Broadband content" means a measureable acoustic signal (greater than 0 A-weighted dB) at all frequencies within a one-third octave band.**

[Broadband content means a measureable acoustic signal (greater than 0 A-weighted dB) at all 1/12th octave bands within a one-third octave band.]

4.2. **"Fundamental frequency" means, for purposes of this regulation, the lowest** [alternative: prominent] **frequency of a valid measurement.**

4.3. "Pitch Shift Frequency" means any frequency or frequencies used to comply with S5.1.6.

4.4. **Electric vehicle" means a motor vehicle with an electric motor as its sole means of propulsion.**

4.5. ***Hybrid Electric Vehicle … see 4.11 ff***

4.6. **"Front plane of the vehicle" means a vertical plane tangent to the leading edge of the vehicle during forward operation.**

4.7. **"Rear plane of the vehicle" means a vertical plane tangent to the leading edge of the vehicle when the vehicle is in a condition in which it is capable of reverse self-mobility.**

4.8. "Devices for Approaching Vehicle Alert" shall refer to those devices designed to be equipped in motor vehicles that meet certain requirements described in sections 2 and 3 below in order to let pedestrians, etc. beware of approaching vehicles, etc.

4.9. *"Electric Vehicle I (EV-I)" means a road transport vehicle whose drive-train consists of one or more electric motors that receive their energy from one or more externally charged batteries.*

4.10. *"Electric Vehicle II (EV-II)" means a road transport vehicle whose drive-train consists of one or more electric motors that receive their energy from one or more batteries that are charged by an on-board internal combustion engine that is not connected to the vehicle drive-train.*

4.11. *"Hybrid Electric Vehicle I (HEV-I)" means a road transport vehicle whose drive-train incorporates a combination of electric motors and an internal combustion engine that powers an electric generator to charge the batteries and also provides direct motive power to the drive-train on demand.*

4.12. *"Hybrid Electric Vehicle II (HEV-II)" means a road transport vehicle whose permanent internal combustion drive train can be supplemented by electric motors.*

4.13. ***"Hybrid Electric Vehicle III (HEV-III)" means a road transport vehicle whose power train consists of two propulsion systems (one of which is electrical); the non-electric can be completely turned off and disconnected, so that the vehicle propulsion is purely electrical.***

4.14. *"Internal Combustion Engine Vehicle (ICEV)" means a road transport vehicle whose operation relies entirely upon an internal combustion engine to power its drive-train.*

4.15. *"AVAS" means Audible Vehicle Alert System; A system fitted to a vehicle that emits audible sound(s) intended to give information to other road users.*

4.16. *"Attenuation" Reduction of the sound emitted by an AVAS.*

4.17. *"Attention catcher" means a special sound produced by an AVAS that indicates to pedestrians and road users the start of vehicle movement.*

4.18. *"Ready for Movement" means the sound produced by an AVAS that indicates all vehicle controls necessary to initiate immediate vehicle movement are ready for driver action.*

4.19. *"Pitch shifting" means the variation of the frequency content of the AVAS sound as a function of the vehicle speed.*

4.20. *"Directivity" means a measure of the directional characteristics of a sound source when mounted on a vehicle.*

4.21. *"Modulation" means the repetitive time dependant variation of the sound amplitude produced by an AVAS .*

4.22. "Authority" (see "certification authority" and "Contracting Party").

4.23. "Certification authority" means the authority that grants the compliance certification of an AVAS system according to this gtr. Per extension, it means also the technical service that has been accredited to evaluate the technical compliance of the AVAS system.

4.24. "Contracting Party" means the party signatory to the 1998 Agreement.

4.25. ***"Commencing Motion Sound" is a sound increase (sound peak) which indicates that a vehicle is starting to move.***

5. GENERAL REQUIREMENTS ***(OICA COMMENT: ALL LINKS PROVIDED IN THE TEXT ARE NOT UPDATED)***

Each vehicle must meet the requirements specified under the test conditions and the test procedures specified in this Regulation.

If AVAS is installed on a vehicle, it shall fulfil the requirements referred to below.

6. PERFORMANCE REQUIREMENTS

6.1. Start up and stationary but activated.

6.1.1 ***Option 1: Stationary Sound***

When measured according to the test conditions of S6 and the test procedure of S7.2, the vehicle must, within 500msec of activation of its starting system, emit a sound having at least the A-weighted sound pressure level in each of the one-third octave bands according to Table 1 (see Appendix 1). The vehicle must also emit a sound meeting these requirements whenever moving at less than 10 km/h.

6.1.2 ***Option 2: Commencing Motion Sound***

When measured according to the test conditions of S6 and the test procedure of 7.2, the commencing motion sound shall be activated when the vehicle's drive selector is placed in drive or reverse, the parking and the service brakes are released. After the brakes are released, the peak of the commencing motion sound shall reach within [500] ms at least a [6] dB(A) higher level relative to the following minimum.

6.2. Directivity.

When measured according to the test conditions of S6 and test procedure of S7.2, the sound measured at the microphone on the line CC' must have at least the A-weighted sound pressure level in each of the one-third octave bands according to Table 1 (see Appendix 1).

6.3. Backing.

For vehicles capable of rearward self-propulsion, whenever the vehicle's gear selection control is in the reverse position, the vehicle must emit a sound having at least the A-weighted sound pressure level in each of the one-third octave bands according to Table 2 (see Appendix 1) as measured according to the test conditions of S6 and the test procedure of S7.3.

6.4. Constant 10 km/h pass by

When tested under the conditions of S6 and the procedures of S7.4, the vehicle must emit a sound having at least the A-weighted sound pressure level in each of the one-third octave bands according to Table 3 at any speed greater than or equal to10 km/h, but less than 20 km/h.

If after a vehicle to which this standard applies according to paragraph S3(b) or S3(c) is tested in accordance with paragraphs S7.4, for ten consecutive times without recording a valid measurement because the vehicle's ICE remains active for the entire duration of the test, the vehicle is not required to meet the requirements in S5.1.3.

If after a vehicle to which this standard applies according to paragraph S3(b) or S3(c) is tested in accordance with paragraphs S7.4, for ten consecutive times within a series of measurements without recording a valid measurement according to S7.1.3.1 because the vehicle's ICE restarts and interferes with the measurements, the vehicle is not required to meet the requirements in S5.1.3.

6.5. Constant 20km/h pass by

When tested under the conditions of S6 and the procedures of S7.5, the vehicle must emit a sound having at least the A-weighted sound pressure level in each of the one-third octave bands according to Table 4 at any speed greater than or equal to 20 km/h but less than 30 km/h.

If after a vehicle to which this standard applies according to paragraph S3(b) or S3(c) is tested in accordance with paragraphs S7.5, for ten consecutive times without recording a valid measurement because the vehicle's ICE remains active for the entire duration of the test, the vehicle is not required to meet the

requirements in S5.1.4.

If after a vehicle to which this standard applies according to paragraph S3(b) or S3(c) is tested in accordance with paragraphs S7.4, for ten consecutive times within a series of measurements without recording a valid measurement according to S7.1.3.1 because the vehicle's ICE restarts and interfers with the measurements, the vehicle is not required to meet the requirements in S5.1.3.

6.6. Constant 30km/h pass by

When tested under the conditions of S6 and the procedures of S7.6, the vehicle must emit a sound having at least the A-weighted sound pressure level in each of the one-third octave bands according to Table 5 at 30 km/h.

If after a vehicle to which this standard applies according to paragraph S3(b) or S3(c) is tested in accordance with paragraphs S7.6, for ten consecutive times without recording a valid measurement because the vehicle's ICE remains active for the entire duration of the test, the vehicle is not required to meet the requirements in S5.1.5.

If after a vehicle to which this standard applies according to paragraph S3(b) or S3(c) is tested in accordance with paragraphs S7.4,

for ten consecutive times within a series of measurements without recording a valid measurement according to S7.1.3.1 because the vehicle's ICE restarts and interfers with the measurements, the vehicle is not required to meet the requirements in S5.1.3.

6.7. Pitch shifting to signify acceleration and deceleration.

The fundamental frequency of the sound emitted by the vehicle must vary with speed by at least one percent per km/h between 0 and 30 km/h.

At least one pitch shift frequency of the sound emitted by the vehicle must vary within each individual gear ratio with speed by at least one per cent per km/h between 0 and [30] km/h.

6.8. Performance requirements for recognition as a motor vehicle.

The sound emitted by the vehicle to meet the requirements in S5.1.1 must contain at least one tone. A component is defined as a tone if the total sound level in a critical band centered about the tone is 6 dB greater than the noise level in the band.

The sound emitted by the vehicle to meet the requirements in S5.1.1 must have at least one tone no higher than 400 Hz.

The sound emitted by the vehicle to meet the requirements in S5.1.1 must have

broadband content in each one-third octave band from 160 Hz to 5000 Hz.

OICA comment to NPRM: Proposal to delete 6.8 completely.

6.9. **Sameness *(OICA REMARK: This should be covered under COP)***

6.10. **Any two vehicles of the same make, model, and model year (as those terms are defined at 49 CFR 565.12) must emit the same sound as measured by the test required in S5.1.1 within 3 A-weighted dB in each one-third octave band from 160 Hz to 5000 Hz**

6.11. Sameness

6.11.1. Any two vehicles of the same make, model, and model year must emit the same sound within a set of sounds as measured by the test required in S5.1.1 within a [6] A-weighted dB overall level.

6.11.2. Vehicle manufacturers may offer its vehicle to the customer with one or more alternative sounds; each of these sounds is fulfilling the minimum requirements defined within this standard.

6.11.3. Vehicle manufacturers may define two or more alternative sounds which can be selected by the driver during vehicle operation; each of these sounds is fulfilling the minimum requirements defined within this standard

6.12. Method of sound generation

Devices for Approaching Vehicle Alert shall automatically generate sound at least in a speed range from the start of a vehicle until reaching 20km/h ***(not including stationary)*** and when moving rearward; provided,
However, that sound generation shall not be required for those vehicles equipped with internal combustion engines while such engines are activated.

Further, for those vehicles equipped with devices for alerting rearward move, sound generation by the Devices for Approaching Vehicle Alert shall not be required when moving rearward

6.13. Pause Switch ***(OICA: Definition needed)***

Devices for Approaching Vehicle Alert may be equipped with a mechanism to temporarily halt the operation of the device (hereinafter, the “Pause Switch”).
However, when a Pause Switch is installed, an indicator showing to the driver that the Device for Approaching Vehicle Alert is suspended shall be installed.

Furthermore, even when a Device for Approaching Vehicle Alert is suspended by the Pause Switch, a setup shall be provided so that the Device will not remain suspended.

Further, the Pause Switch shall be easily recognized and operated by the driver in a normal position

6.14. Types and Volume of Sound Generation

6.14.1. The sound generated shall be constant sound that reminds people of motor vehicles that are running. In such case, the kinds of sound listed below or similar sounds shall be deemed inappropriate
(i) Siren, chime, bells or melody
(ii) Horn sound
(iv) Sound generated by animals and/or insects such as birdsongs, etc
(v) Sound of natural phenomenon such as wave, wind, river current, etc
(vi) Any other sound that cannot be conceived as being generated by motor vehicles based on a common sense

6.14.2. The sound generated shall be automatically altered in volume or tone depending on the vehicle speed for easier recognition of the move of the vehicle.

6.14.3. Sound volume shall not exceed a level of the sound generated when vehicles driven by internal combustion only run at speed of 20km/h for respective usage of a passenger car, truck, etc.

6.15. Means for Penetration among Vehicles in Use, etc ***(OICA Remark: To be covered by Transitional Provisions)***

In light of quick penetration among vehicles in use, a sound generation device which does not meet every requirement for Devices for Approaching Vehicle Alert but at least meets requirements of 3.(1) and (3) (for devices that generate sound by an operating switch, limited to those with which the sound of 3.(1) is generated continuously for five seconds or longer by a single operation and the operating switch is easily recognized and operated by the driver in a normal position) may be installed as simplified devices that alert approaching vehicles even when such device does not meet other requirements, and sound volume and other details shall be issued separately following more elaborate studies

6.16. Sound generation method

The AVAS shall automatically generate a sound in the minimum range of vehicle speed from start up to approximately 20 km/h ***(not including stationary)*** and during reversing, if applicable for that vehicle category. In case the vehicle is equipped with an internal combustion engine that is in operation within the vehicle speed range defined above, the AVAS may not need to generate a sound. For vehicles having a reversing sound warning device, it is not necessary for the AVAS to generate a sound during backup.

6.17. Pause switch

6.18. The AVAS may have a switch to stop its operation temporarily ("pause switch").
If a pause switch is introduced, however, the vehicle should also be equipped with a device for indicating the pause state of the vehicle approach informing device to the driver in the driver's seat. The AVAS should remain capable of re-operating after stopped by a pause switch. If fitted in the vehicle, a pause switch should be located in such a position that the driver will find and manipulate it with ease.

6.19. Attenuation

The AVAS sound level may be attenuated during periods of vehicle operation.

6.20. Sound type and volume

The sound to be generated by the AVAS should be a continuous sound that provides information to the pedestrians and vulnerable road users of a vehicle in operation.
However, the following and similar types of sounds are not acceptable:

(i) Siren, horn, chime, bell and emergency vehicle sounds
(ii) Alarm sounds e.g. fire, theft, smoke alarms
(iii) Intermittent sound The following and similar types of sounds should be avoided:
(iv) Melodious sounds, animal and insect sounds
(v) Sounds that confuse the identification of a vehicle and/or its operation (e.g. acceleration, deceleration etc.)

The sound to be generated by the AVAS should be easily indicative of vehicle behaviour, for example, through the automatic variation of sound level or characteristics in synchronization with vehicle speed. (c) The sound level to be generated by the AVAS should not exceed the approximate sound level of a similar vehicle of the same category equipped with an internal combustion engine and operating under the same conditions.

6.21. Frequency specifications

Frequency range of audible signal: between 50 Hz and 5 kHz

6.22. Frequency content

The frequency content should include at least two 1/3 octave bands within that range given above.
In the case where the AVAS produce only two frequencies, they should differ by at least 15%.

An alerting signal's mid frequencies (0,5 kHz to 2 kHz), higher frequencies (2 kHz to 5 kHz) support audibility and directional cues. Low frequencies (below 500Hz) support earlier detection but in an urban environment are at risk of being masked.

6.23. Sound Level
To be elaborated.

6.24. Pitch Shifting

A monotonic change of the major frequency content is very typical for machinery sound. The use of pitch shifting strongly excludes animal sound. The pitching rate, which is proportional to vehicle speed, ensures a variation of the sound which is readily detected when the vehicle is in transient operation (acceleration / deceleration).

Presently used pitch shifting frequencies range from a low of 0.6 kHz to a high of 2.5 kHz.

It is recommended that during acceleration or deceleration an increase or decrease of at least 8% be demonstrated between 10 km/h and 20 km/h. This pitch shift should be verified by SAE J 2889-1:2011.

6.25. Frequency Modulation

Used to simulate sound of "firing beat" of internal combustion engine. Modulation frequency is generally less than 0.6 kHz.

6.26. Volume Shifting

Vehicle sound increases or decreases as a function of the vehicle acceleration or deceleration. This is a physical phenomenon produced to varying degrees by most road vehicles. The volume shifting can provide an enhancement for detection at greater distance.

To ensure that this typical characteristic is kept and to avoid masking of the “signal of interest” by tyre rolling sound, a volume increase may be necessary.

In addition, the QRTV / IWG recommends that if volume shifting of the alerting device is to be required, it is preferable that the vehicle emits higher sound level at higher speeds.

6.27. Vehicle at Stationary
It is further recommended that the sound level be automatically attenuated during these periods to a level that is adequate to be heard by a pedestrian who is at the curb, immediately adjacent to the vehicle, in preparation of crossing the intersection - the specific SPL must be determined based on required signal characteristics. This requirement is not intended to relieve the driver of the vehicle of responsibility for the safety of the pedestrian but rather to acknowledge that some jurisdictions may not require the generation of a sound when the vehicle is temporarily stationary.

6.28. Alerting System Activation Speed or Crossover Speed
Initial quiet vehicle sound level measurements carried out in accordance with SAE J2889-1, verified that the majority of vehicles tested exhibited a change in their acoustic signature at approximately the same speed. It was concluded that this change was due, in part, to the onset of tire-road interaction and aerodynamic generated sound. Manufacturer and U.S. government testing conducted on smaller, lightweight automobiles revealed the crossover speed to be approximately 20 km/h (12 mph) while several other studies suggest the crossover speed to be 25 km/h (15 mph)26 and between 33 and km/h (20 and 25 mph)27. In addition, there is currently a trend for quieter tires and sound absorbing pavement surfaces that can lead to higher crossover speeds in the future.

6.29. Alerting System Deactivation Speed
The speed at which the alerting system is no longer necessary would be the converse

of the speed for system activation. Based on the above suggested crossover speeds attendant to system activation, the deactivation speed would be between 20 and 41 km/h.

6.30. *Alerting System Duration of Activation at Constant Speed and Late Night Travel*
A key concern arises when we consider that the typical flow of traffic is frequently intermittent or constant at low speed, particularly during peak morning and evening commutes to and from work. In addition, there is the question as to the need for alert system activation during prolonged slow speed operation on highways or boulevards where pedestrian traffic or crossing is prohibited. Finally, there is the issue of the alert

7. TEST PROCEDURES

7.1. Test Conditions

7.1.1. Weather conditions.
The ambient conditions required by this section must be met at all times during the tests described in S7.

7.1.2. Conditions must be measured with the accuracy required in S6.3.3 at the microphone height required in S6.4 +/- 2.54 cm. ***(OICA: ECE R51: +/- 2cm)***

7.1.3. The ambient temperature will be between 5 °C (41°F) and 40 °C (104 °F).

7.1.4. The maximum wind speed at the microphone height is no greater than 5 m/s (11 mph), including gusts.

7.1.5. No precipitation and the test surface is dry.

7.1.6. Background noise level. The background noise level must be measured and reported as in S6.4 of SAEJ2889-1 (incorporated by reference, see § 571.5).

7.1.7. Test surface. Test surface shall meet the requirements of ISO 10844:2011 [ISO 10844:1994 or ISO 10844:2011] **(incorporated by reference, see § 571.5).**

7.2. Instrumentation.

7.2.1. Acoustical measurement. Instruments for acoustical measurement must meet the requirements of S5.1 of SAE J2889-1 (incorporated by reference, see § 571.5).

7.2.2. Vehicle speed measurement. Instruments used to measure vehicle speed during S7.4 and S7.5 of this standard must be capable of continuous measurement within ± 1.0 km/h over the entire test distance in S7.4 and S7.5.

7.2.3. Meteorological instrumentation. Instruments used to measure ambient conditions at the test site must meet the requirements of S5.3 of SAE J2889-1 (incorporated by reference, see § 571.5).

7.3. Test site.

7.3.1. The test site must be established per the requirements of S6.1.1 of SAE J2889-1 (incorporated by reference, see § 571.5), including Figure 1, "Test Site Dimensions" with the definitions of the abbreviations in Figure 1 as given in Table 1, S4 of SAE J2889-1 (incorporated by reference, see § 571.5). Microphone positions must meet the requirements of S7.1 of SAE J2889-1 (incorporated by reference, see § 571.5).

7.3.2. Indoor test facilities meeting specifications in SAE J-2889-1 are an acceptable

alternative to 7.3.1

7.4. Test set up for directivity measurement must be as per S6.4 with the addition of one microphone meeting the requirements of S6.3.1 placed on the line CC', 2m forward of the line PP' at a height of 1.2m above ground level.

7.5. Vehicle condition

7.5.1. Tires will be fitted and pressurized per the vehicle's tire placard. Tire tread will be free of all debris. Tires will be conditioned according to the following procedure:
Drive the test vehicle around a circle 30 meters (100 feet) in diameter at a speed that produces a lateral acceleration of approximately 0.5 to 0.6 g for three clockwise laps, followed by three counterclockwise laps.

7.5.2. Tires will be fitted and pressurized per the vehicle's tire placard. Tire tread will be free of all debris. Before the measurements are started, the tyres shall be brought to its normal operating conditions.

7.5.3. The vehicle's doors are shut and locked and windows are shut.

7.5.4. The vehicle's doors and windows are shut. In case of self-lockable vehicles the doors shall be locked before starting the measurement.

7.5.5. All accessory equipment (air conditioner, wipers, heat, HVAC fan, audio/video systems, etc.) will be off. Propulsion battery cooling fans and pumps and other components of the vehicle's propulsion battery thermal management system are not considered accessory equipment.

7.5.6. All accessory equipment (air conditioner, wipers, heat, HVAC fan, audio/video systems, etc.) that can be shut down, will be off. Propulsion battery cooling fans and pumps and other components of the vehicle's propulsion battery thermal management system are not considered accessory equipment.

7.5.7. Test weight of the vehicle will be the curb weight (as defined in 571.3) plus 125 kilograms. Equipment, driver and ballast should be evenly distributed between the left and right side of the vehicle. Do not exceed the GVWR or GAWRs of the vehicle.

7.5.8. Test weight of the vehicle will be the curb weight (as defined in 571.3) plus driver and test equipment with a 10% tolerance. ***(OICA: Use ECE Definition)***

7.5.9. Vehicle's electric propulsion batteries, if any, are fully charged.

7.5.10. Before the measurements are started, the vehicle's electric propulsion batteries, if any, are fully charged as specified by the manufacturer ***with a tolerance of [10%]*** .

7.6. Ambient correction

7.6.1. Measure the background noise for at least 30 seconds before and after a series of vehicle tests.

7.6.2. A 10-second sample taken from these measurements will be used to calculate the reported background noise.

7.6.3. The 10-second sample selected will include background levels that are representative of the background levels that will occur during the vehicle measurement.

7.6.4. The minimum A-weighted SPL in the selected 10-second sample as the overall background noise level, Lbgn will be reported. The average A-weighted SPL in the same 10-second sample will also be noted.

7.6.5. The minimum A-weighted 1/3 octave band levels (OBLs) (per ANSI S1.11, Class 1) in the selected 10-second sample will be reported as the 1/3 octave band background noise level, OBLbgn, fc. The average A-weighted 1/3 octave band level in the same 10-second sample for each 1/3 octave band will also be noted.

7.6.6. Each 1/3 octave band of the measured jth test result within a test condition OBLtest,j,fc, will be corrected according to Table 6 to obtain the noise-corrected level OBLtestcorr, j, fc which is the OBLtest, j, fc minus the correction factor, Lcorr.

7.6.7. Ensure that maximum allowable peak-to-peak variation occurs in not more than one measurement for each operation during the portion of the measurement that will be reported, e.g. within the second prior to pass-by or during an entire active but stationary measurement.

7.6.8. Ensure that the background level is at least 10 dB below the measurement during any portion of the measurement that will be reported, e.g. within the second prior to pass-by or during an entire active but stationary measurement.

7.7. Background noise

7.7.1. A background noise representative for the period of the measurement shall be measured for 10 seconds before or after a series of vehicle tests.

7.7.2. The 10-second sample will be representative of the background levels that will occur during the vehicle measurement.

7.7.3. The overall background level is at least 10 dB below the measurement during any portion of the measurement that will be reported, e.g. within the second prior to pass-by or during an entire active but stationary measurement.

7.7.4. The test engineer shall ensure that the background noise does not interfere during the measurement. If a noise peak obviously out of character with the general sound pressure level is observed, the measurement shall be discarded..

7.8. VEHICLE TESTING

7.8.1. Vehicle stationary but activated

7.8.1.1. Option 1: Stationary Sound

7.8.1.1.1. Position the vehicle stationary with the front plane at the line PP', the centerline on the line CC' and the starting system deactivated.

7.8.1.1.2. For vehicles equipped with a Park position, place the vehicle's gear selection control in "Park". For vehicles not equipped with a Park position, place the vehicle's gear selection control in "Neutral" and engage the parking brake. Activate the starting system to energize the vehicle's starting system.

The vehicle's gear selection control shall be placed in "D" and the brake released.

7.8.1.1.3. The vehicle minimum sound pressure level shall be measured per S7.3.2.1 and S7.4.1 of SAE J2889-1 (incorporated by reference, see § 571.5) and corrected for the ambient sound level in each 1/3 octave band according to the procedure in S6.7 and the correction criteria given in Table 6.

The vehicle minimum sound pressure l*evel* shall be measured per S7.3.2.1 and S7.4.1 of SAE J2889-1 (incorporated by reference, see § 571.5).

7.8.1.1.4. Four consecutive valid measurements must be within 2 A-weighted dB Measurements that contain sounds emitted by any component of a vehicle's battery thermal management system are not considered valid. When testing a hybrid vehicle with an internal combustion engine that runs intermittently, measurements that contain sounds emitted by the ICE are not considered valid.

Four consecutive measurements are considered valid if their overall levels are within a 2 A-weighted dB range. When testing a hybrid vehicle with an internal combustion engine that runs intermittently, measurements that contain sounds emitted by the ICE are not considered valid.

7.8.1.2. Option 2: Commencing Motion Sound

7.8.1.2.1. The vehicle shall be placed with the front plane on the PP' line for driving forward and with the rear plane on the PP' line for backing

7.8.1.2.2. The propulsion system is active, the transmission in drive gear, the parking brake is released and the service brake is activated to hold the vehicle stationary.

7.8.1.2.3. The measurement starts 5 seconds before the service brake is released (brake lights off).

7.8.1.2.4. The signals (time, brake force, SPL) shall be measured for duration of at least 15 seconds.

7.8.1.2.5. The maximum overall A – weighted sound pressure level is measured continuously with fast response mode.

7.8.2. Backing. Test

7.8.2.1. The vehicle per 7.8.1, except that the rear plane of the vehicle is placed on line PP'. Backing.

7.8.2.2. The vehicle per S7.1, except that the rear plane of the vehicle is placed on line PP' and the gear selection control in "R".

7.8.3. Pass-By test at 10km/h

7.8.3.1. Measure the sound emitted by the vehicle at a constant 10 km/h (+/- 1 km/h)

throughout the measurement zone specified in S6.4 between lines AA' and PP'. The test result shall be the lowest value (average of the two microphones) of the four valid pass-bys. The test result shall be reported to the first significant digit after the decimal place.

7.8.3.2. Measure the sound emitted by the vehicle at a constant 10 km/h (+/- 1 km/h) throughout the measurement zone specified in S6.4 between lines AA' and PP'. The test result shall be averaged per side. The final result to be reported is from the vehicle side with the lower level.

7.8.3.3. Four consecutive valid measurements must be within 2 A-weighted dB. Measurements that contain sounds emitted by any component of a vehicle's battery thermal management system are not considered valid. When testing a hybrid vehicle with an ICE that runs intermittently, measurements that contain sounds emitted by the ICE are not considered valid. The test result shall be corrected for the ambient sound level in each 1/3 octave band according to the procedure in S6.7 and the correction criteria given in Table 6 and reported to the first significant digit after the decimal place.

7.8.3.4. Four consecutive measurements are considered valid if their overall levels are within a 2 A-weighted dB range. When testing a hybrid vehicle with an internal combustion engine that runs intermittently, measurements that contain sounds emitted by the ICE are not considered valid. The test result shall be reported to the first significant digit after the decimal place.

7.8.4. Pass by test at 20 km/h. Repeat the test of S7.3 at 20 km/h.

7.8.5. Pass by test at 30 km/h. Repeat the test of S7.3 at 30 km/h.

8. DOCUMENTATION REQUIREMENTS

(OICA: Specs to be added)

9. ANNEXES

(OICA: to be completed)

Annex 1

Spectra Definitions Table 1 to 5

3rd octave band	Table 1 STAT ACT	Table 2 BACKING	Table 3 CRS 10	Table 4 CRS 20	Table 5 CRS 30
	49	52	55	62	66
Hz	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
315	42	45	48	54	59
400	43	46	49	55	59
500	43	46	49	56	60
2000	42	45	48	54	58
2500	39	42	45	51	56
3150	37	40	43	49	53
4000	34	36	39	46	50
5000	31	34	37	43	48

Table 6 for Ambient Correction

Table 6. Corrections for Background Noise			
1/3 Octave Band Noise Level OBLbgn,fc	* Peak-to-Peak 1/3 Octave Band Background Noise Level OBLbgn, fc, p-p	1/3 Octave Band Level of jth test result, ith frequency, minus 1/3 Octave Band Noise Level DL = OBLtest,j, fc - OBL bgn, fc	Correction Lcorr
≥ 25 dB(A)	**	> 10 dB	0 dB
	< 8 dB	> 8-10 dB	0.5 dB
		> 6-8 dB	1.0 dB
	< 6 dB	> 4.5-6 dB	1.5 dB
		> 3-4.5 dB	2.5 dB
		≤ 3 dB	Do not correct, but report OBLtestcorr, j < OBLtestj

< 25 dB(A)		≤10 dB	Do not correct, but report OBLtestcorr, j < OBLtestj
	**	> 10 dB	0 dB