

Concept of QRTV gtr based on R.E.3

JASIC

	Description in the R.E.3	Concept and Discussion point
<p>3. Operation conditions</p> <p>(a) Sound generation method</p>	<ul style="list-style-type: none"> ➤ The AVAS shall automatically generate a sound at least in the range of vehicle speed from start up to 20 km/h 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 	<ul style="list-style-type: none"> ➤ Concept The range of vehicle speed to be as described in the guideline. (No requirement when the vehicle is stopped.) ➤ Discussion point Sound generation for when the vehicle is stopped; Sound generation for the vehicle speed of more than 20 km/h. ➤ Information (Supplementary information 1) Cases where safety is ensured more by not generating sound when the vehicle is stopped (Supplementary information 2) No difference of detectability between the engine on and off at 20 km/h or higher



	Description in the R.E.3	Concept and Discussion point
<p>3. Operation conditions</p> <p>(b) Pause switch</p>	<ul style="list-style-type: none"> ➤ 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. 	<ul style="list-style-type: none"> ➤ Concept <p>The pause switch to be optional for contracting party as described in the guideline or prohibited.</p>

	Description in the R.E.3	Concept and Discussion point
<p>3. Operation conditions</p> <p>(c) Attenuation</p>	<p>➤The AVAS sound level may be attenuated during periods of vehicle operation.</p>	<p>➤Concept</p> <p>Attenuation to be as described in the guideline.</p>

	Description in the R.E.3	Concept and Discussion point
<p>4. Sound type and volume</p> <p>(a) Sound type</p>	<p>➤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.</p>	<p>➤Concept</p> <p>Sound type to be as described in the guideline.</p>

	Description in the R.E.3	Concept and Discussion point
<p>4. Sound type and volume</p> <p>(a) Sound type-prohibited</p>	<p>➤The following and similar types of sounds are not acceptable:</p> <ul style="list-style-type: none"> (i) Siren, horn, chime, bell and emergency vehicle sounds (ii) Alarm sounds e.g. fire, theft, smoke alarms (iii) Intermittent sound <p>The following and similar types of sounds should be avoided:</p> <ul style="list-style-type: none"> (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.) 	<p>➤Concept</p> <p>As described in the guideline.</p>

	Description in the R.E.3	Concept and Discussion point
<p>4. Sound type and volume</p> <p>(b) Pitch shift</p>	<p>The sound to be generated by the AVAS should be <u>easily indicative of vehicle behavior</u>, for example, through the automatic variation of sound level or characteristics in synchronization with vehicle speed.</p>	<ul style="list-style-type: none"> ➤ Concept Pitch shift (frequency shift) should be quantified. ➤ Discussion point We understand the necessity of the frequency shift rate provision, but it would not be feasible without a practical test method. To be accepted the manufacturer's report?

	Description in the R.E.3	Concept and Discussion point
<p>4. Sound type and volume</p> <p>(c) Sound volume</p>	<p>➤ 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.</p>	<p>➤ Concept</p> <p>a) The requirement for the sound to be minimum O.A. sound level and 1/3 octave band frequency. (See the QRTV report which recommends two frequency peaks.)</p> <p>b) The test method to be followed ISO/CD16254 as a start point.</p> <p>➤ Discussion point</p> <p>Specification of minimum O.A. sound level; Specification of 1/3 octave bands.</p> <p>➤ Information</p> <p>(Supplementary information 3) Explain that the O.A. sound level can be enough information for detectability.</p> <p>(Supplementary information 4) Explain that the two peaks are for addressing the risks associated with the various levels of the ability of hearing and background noise.</p>



QRTV Recommendation

4. Sound type
and
volume

(c) Sound
volume

- Based in part on the information and data obtained from multiple sources, both verbal and published, and extensive debate within the Work Group, the QRTV / IWG recommends the following operating frequency specifications be considered:
1. Frequency range of audible signal: between 50 Hz and 5 kHz
 2. Frequency content:
 - a) The frequency content should include at least two 1/3 octave bands within that range
 - b) In the case where the AVAS produces only two frequencies, they should differ by at least 15%.
 - c) 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.

Supplement

Safety Concerns About Sounds From HVs/EVs at Stop

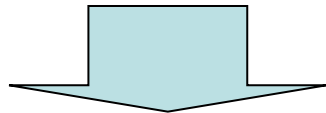
**Safety risk confirmed with HVs/EVs at Stop:
Results of the practical demonstration planned
jointly by MLIT and automakers**

(Vehicles)

**HVs/EVs (PRIUS, LEAF, iMiEV)
at stop emitting sounds**

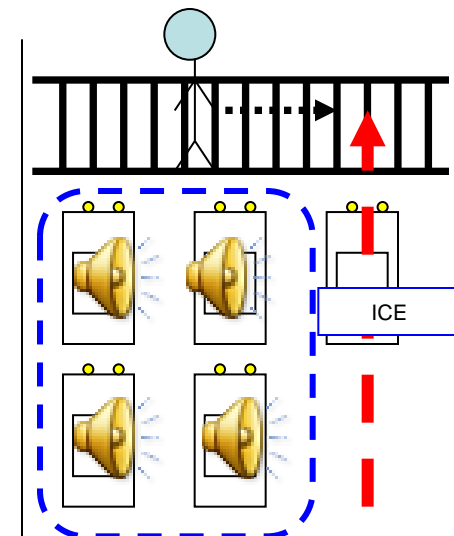
(Scene)

- Two or more HVs emit sounds while at stop
- Pedestrians pass in front of them. ICE cars pass by the pedestrians.



Comments from the participants

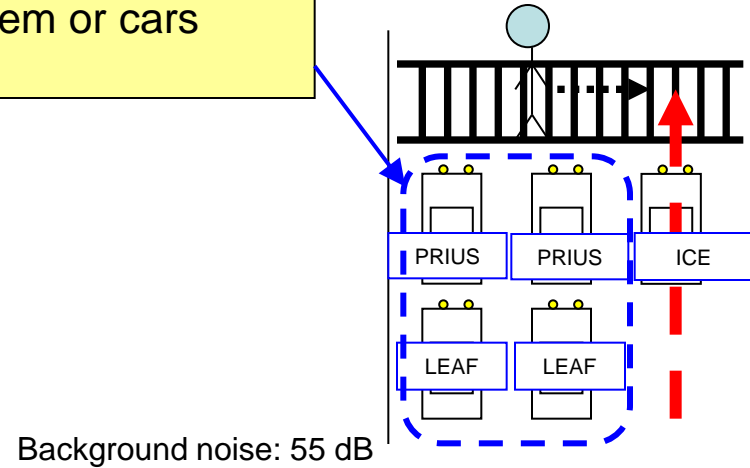
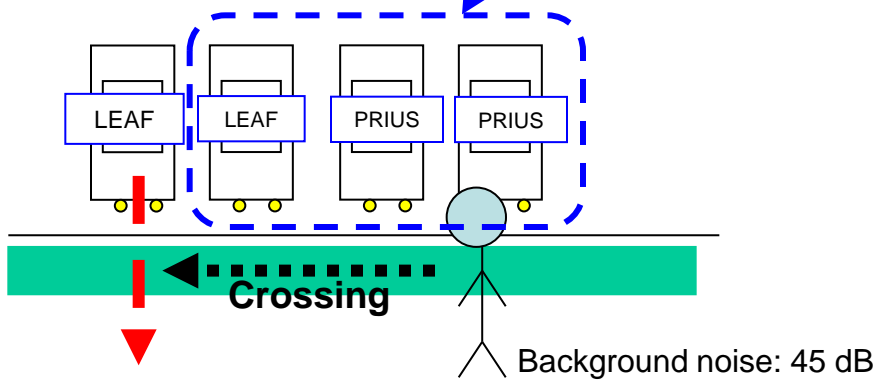
- **Might reduce pedestrians' detectability**
In certain circumstances, sound emission might pose safety risks (See next page)
- **Sounds from multiple HVs/EVs at stop may increase environment noise.**



Risk posed by sounds from HVs/EVs at stop:

- => Similar sounds being emitted by many cars make it difficult for pedestrians to identify the behavior of individual vehicles.**
- => It would be better they don't emit these sound while at stop.**

Sounds from cars at stop make it difficult for pedestrians to identify cars passing by them or cars starting off



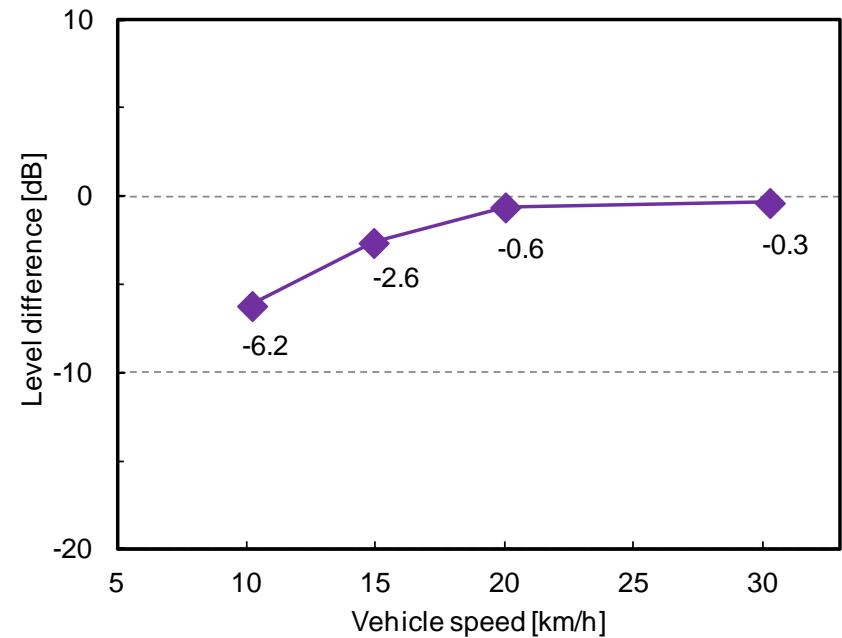
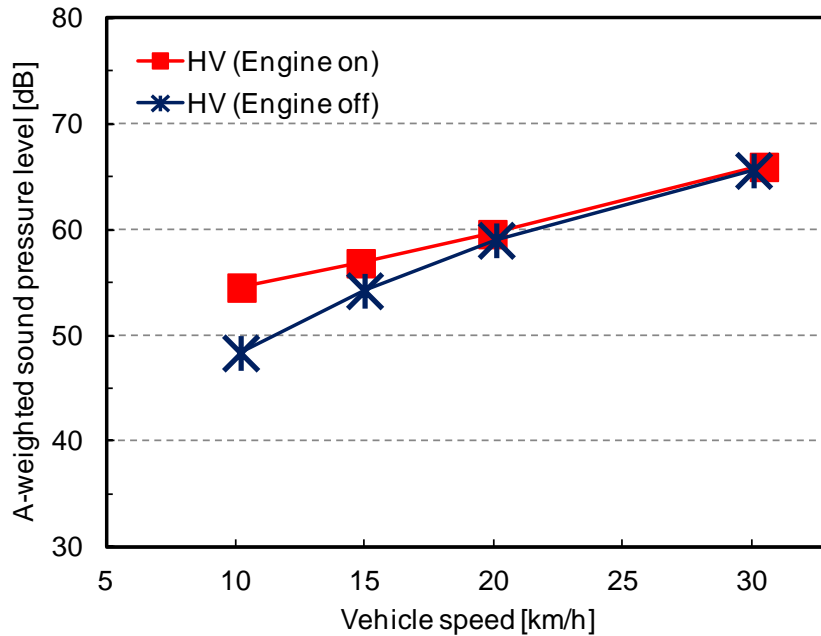
Vehicle Speeds Requiring AVAS

- (1) Comparison of sound emitted
 - * HV with the engine on or off

- (2) Comparison of detectability
 - * HV with the engine on or off

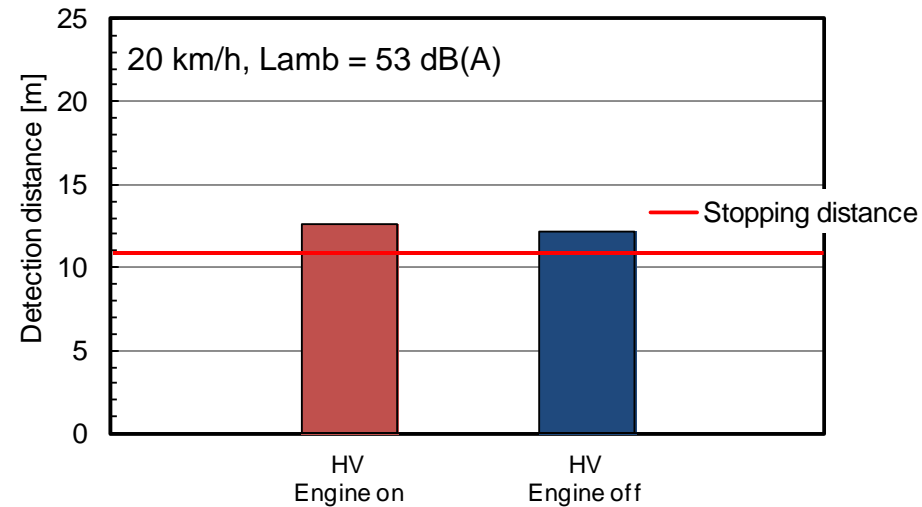
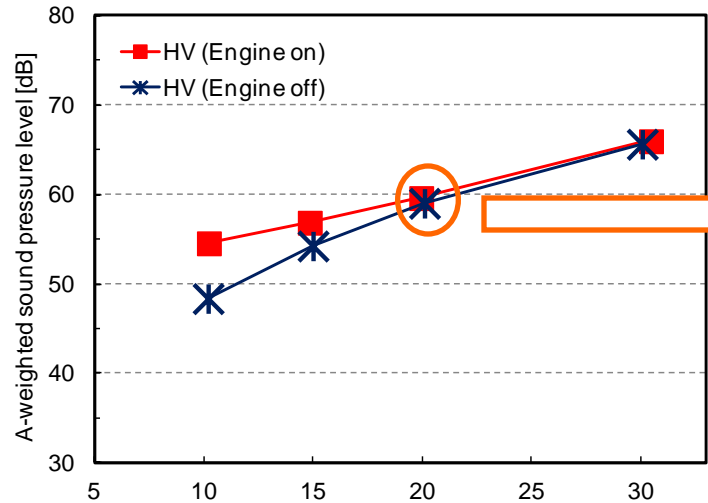
- (3) Comparison of sound emitted
 - * Other vehicles with the engine on or off

HV
"Engine on" vs "Engine off"



Above 20 km/h, the sound level of the same HV doesn't change, whether the engine is on or off.

HV "Engine on" vs "Engine off"



The detection distances at which pedestrians notice an approaching HV are similar, whether the engine is on or off, when the HV is running at 20 km/h.

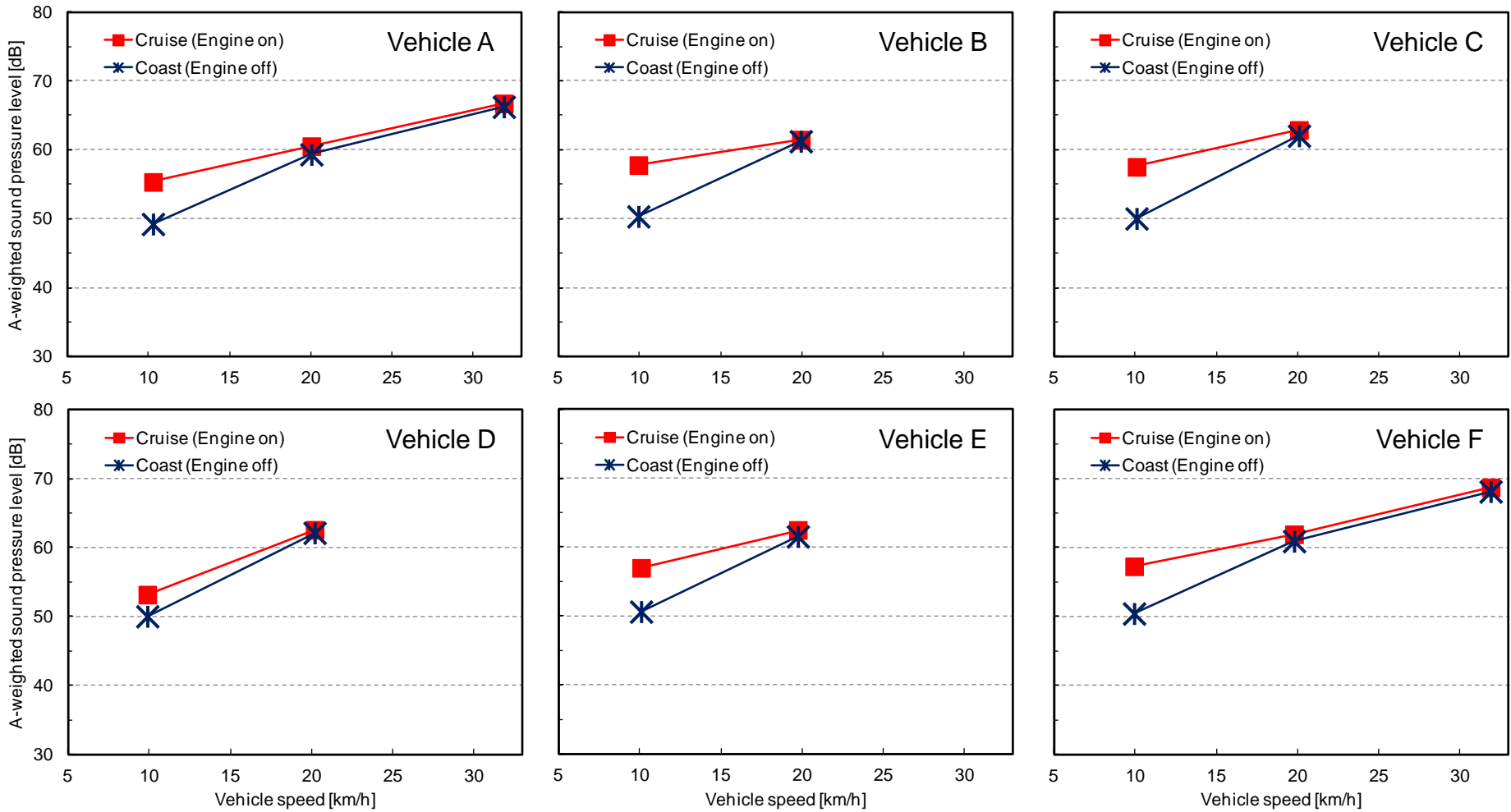
They notices the HV before it comes to the stopping distance.

→ AVAS is not necessary at 20 km/h or over

(3) Comparison of sound emitted



ICE vehicle " Engine on(Cruise)" vs " Engine off(Coast)"



The noise level don't change whether the engine is on or off while cruising above 20 km/h for ICE cars as well.

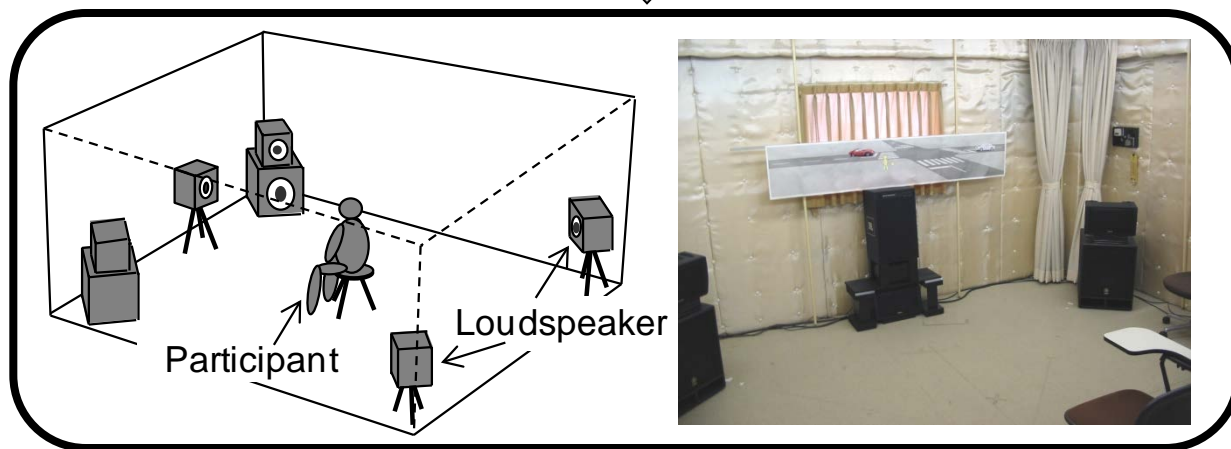
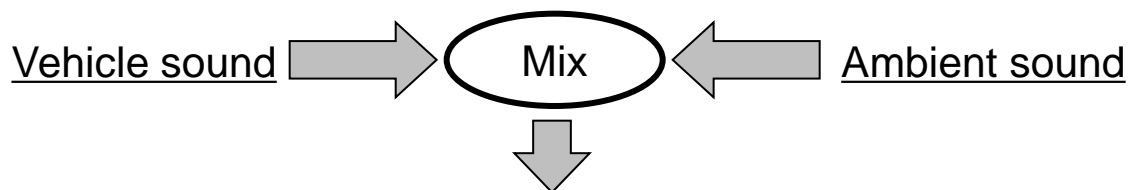
Relationship of OA Sound Level and Detectability

Test vehicles	2 ICE vehicles (1.5L, 4.3L Gasoline) 4 HV/EVs without AVAS 3 HV/EVs with AVAS
Subjects of evaluation	Cruising vehicle sound (Overall level) Detection distance
Evaluation method	Next slide
Background noise	53~54 dB(A), recorded in real world

"Sound recording" and "Detection distance evaluation"



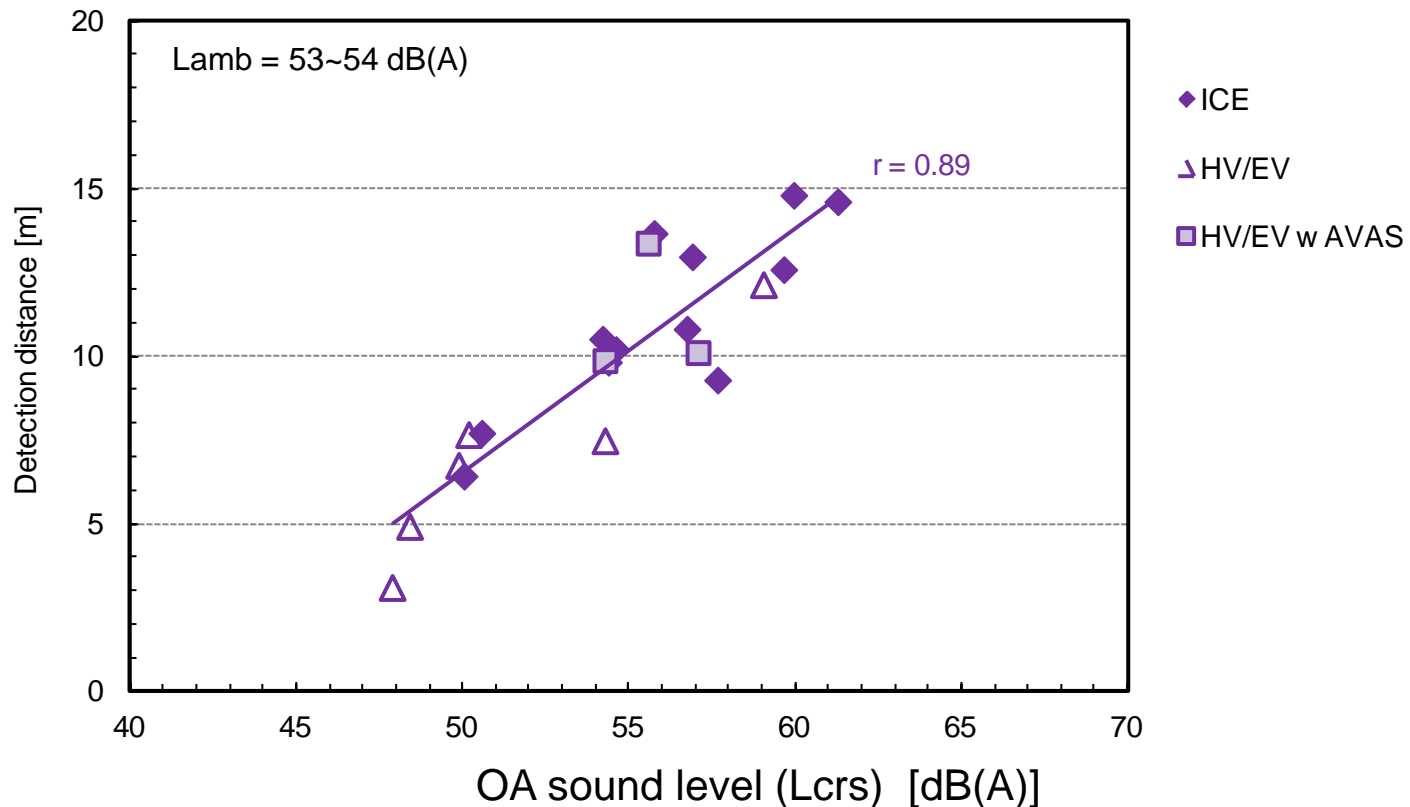
"Sound recording"



"Detection distance evaluation"

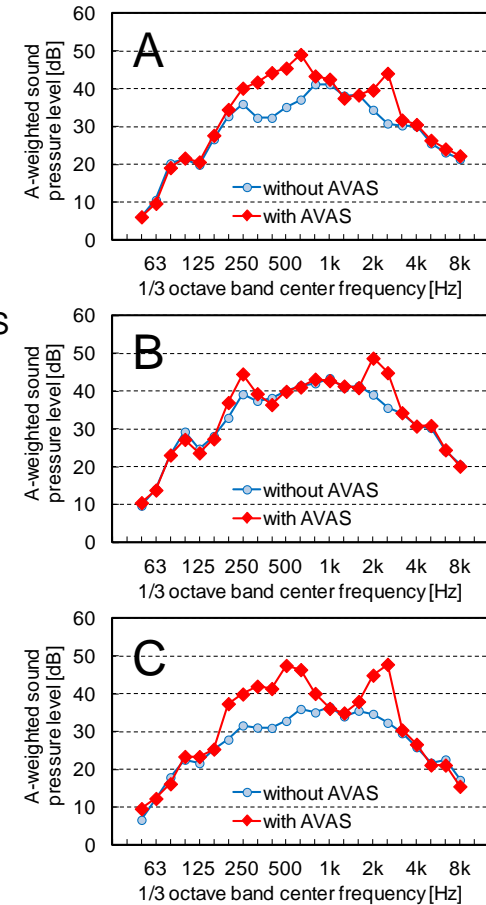
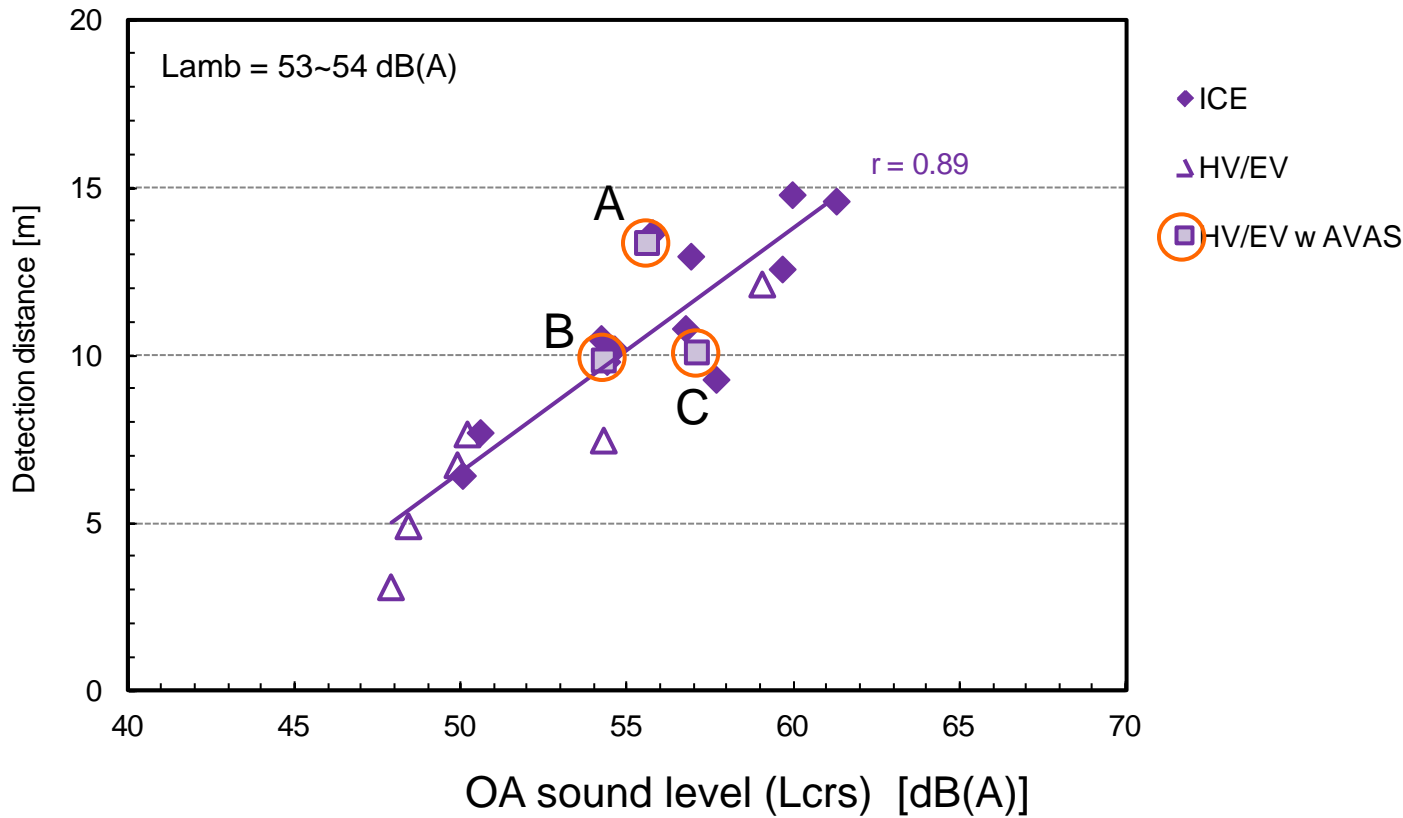
Vehicle sound and ambient noise were mixed and presented to the panelists. The panelists evaluated the detection of approaching vehicle.

"Cruising vehicle sound (Lcrs)" vs "Detection distance"



- There is good correlation between Lcrs OA sound level and the detection distance.
- It is the same tendency as for HV/EV or HV/EV with AVAS as well.

"Cruising vehicle noise (Lcrs)" vs "Detection distance"



- OA sound level with various sound characteristics can indicate detectability (detection distance).

“Tow Peaks” AVAS Sound Concept

- A** Outstanding peak frequency *between 2 kHz and 5kHz* is effective for providing good detectability for *sighted pedestrians*
- B** Outstanding peak *under 1 kHz* frequency to help provide good detectability for *hearing loss people*
- C** Frequency peaks at the *‘shoulders of the 1 kHz peak’* will allow an overall lower sound pressure level while maintaining effectiveness and a quiet environment for driver and community

