

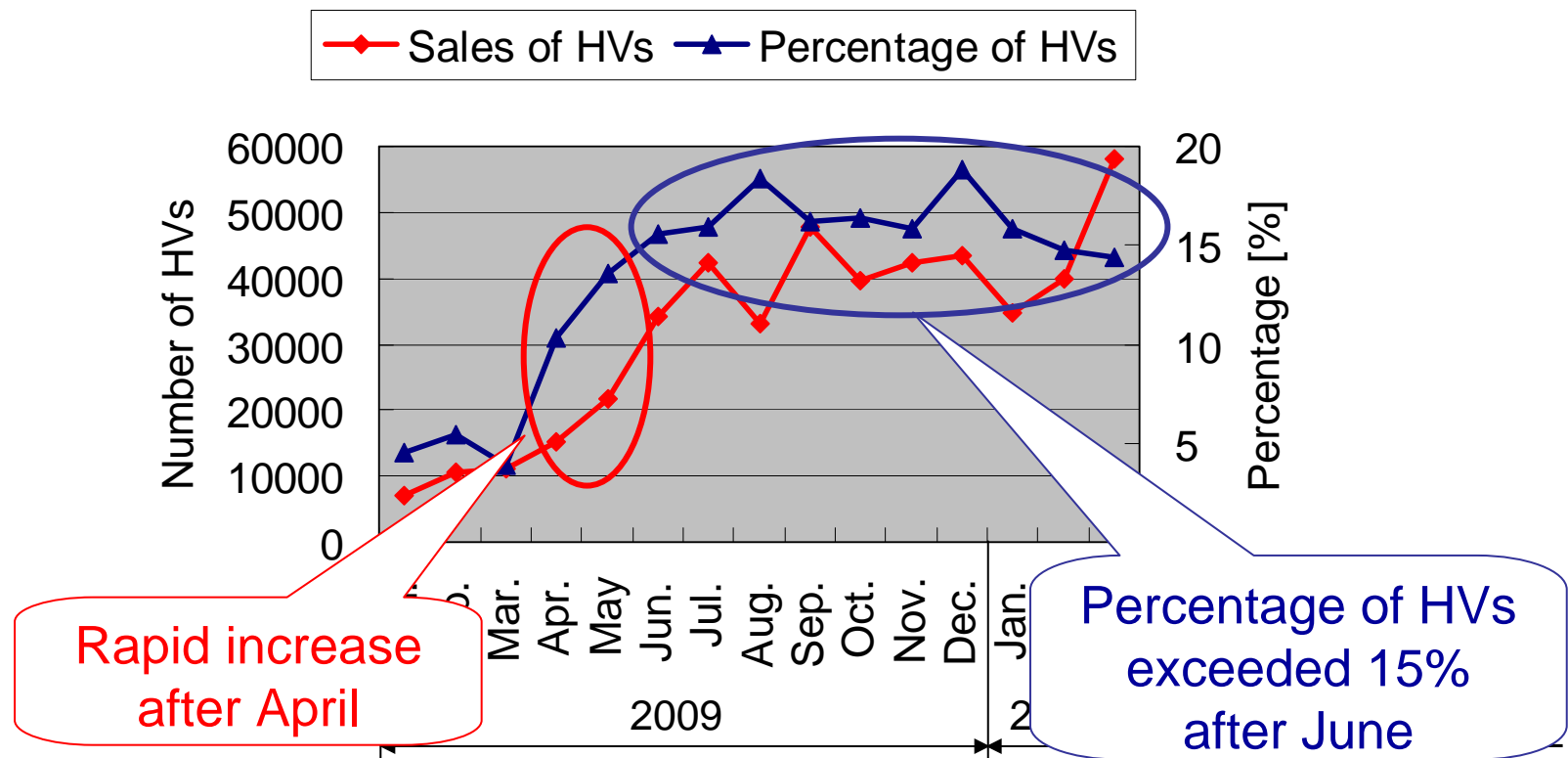
# **Guideline for Measure against Quietness Problem of HV, etc.**

(Released on 29. January 2010 in JAPAN)

**July 13, 2010**  
**MLIT, JASIC**

# Background (1)

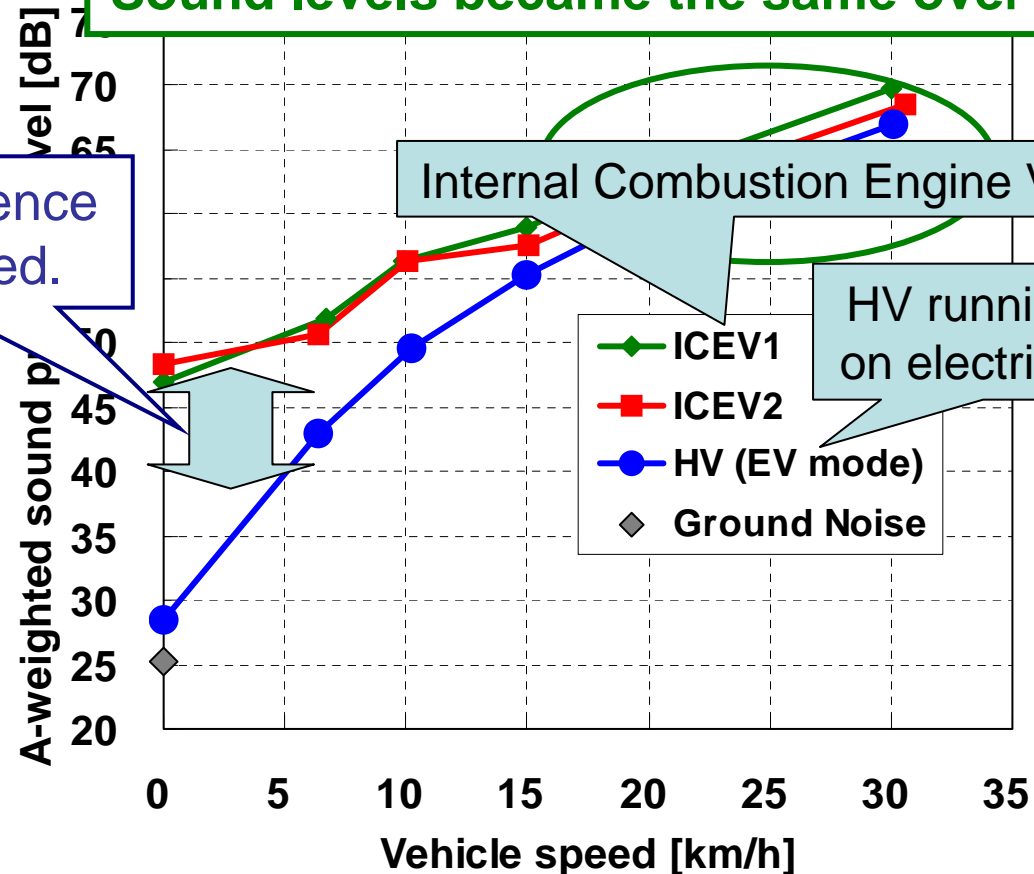
- For fuel economy and lower emissions of CO<sub>2</sub> as a greenhouse gas, the number of environmentally friendly vehicles such as Hybrid vehicles (HVs) and electric vehicles (EVs) are rapidly increasing in Japan.
- They are expected to spread much more in the future.



# Background (2)

- The quietness of these vehicles owing to their structure could cause accidents, such as hitting pedestrians (esp. blind or visually-handicapped people) who are not aware of their approach.

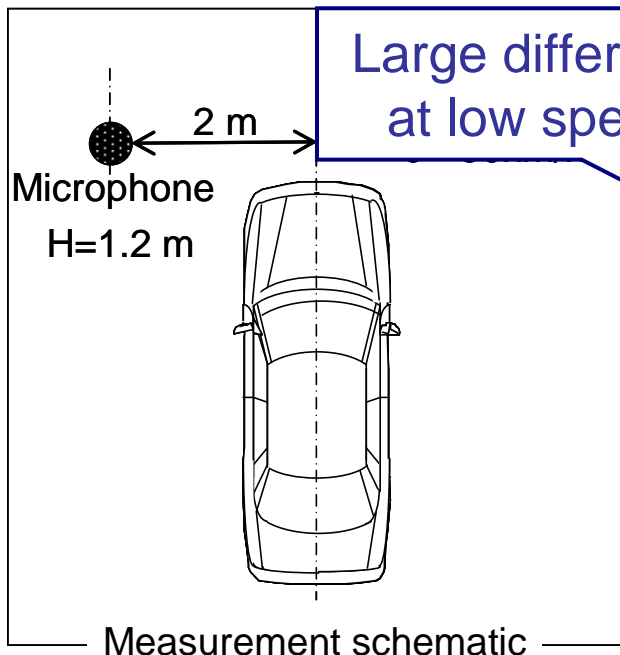
Sound levels became the same over 20km/h



Large difference at low speed.

Internal Combustion Engine Vehicle

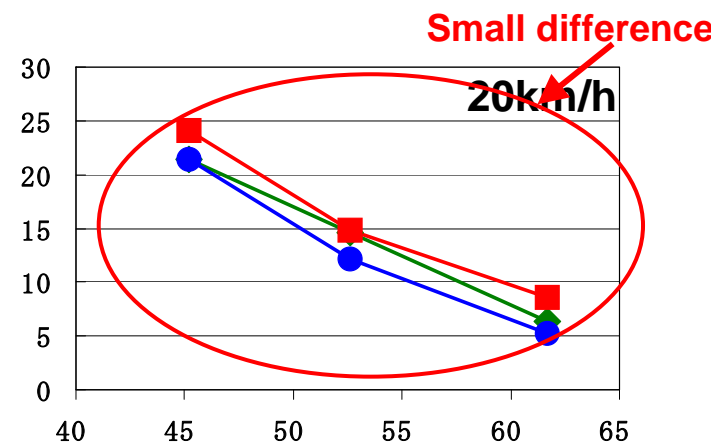
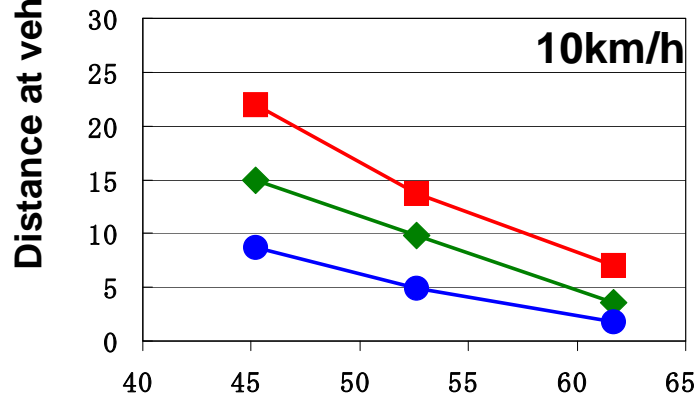
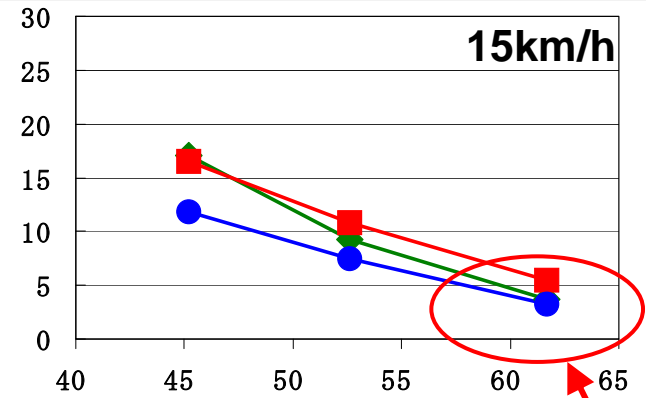
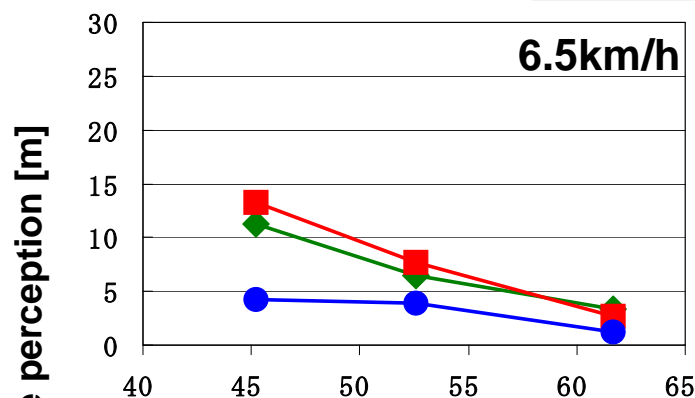
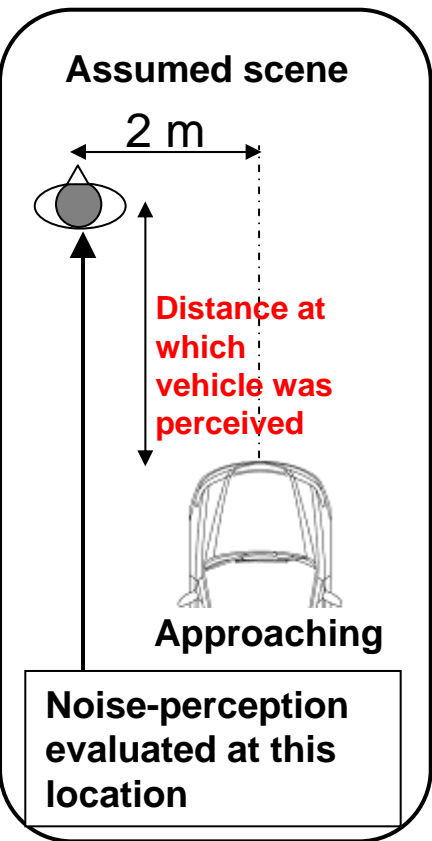
HV running only on electric motor



# Background (3)

## ◆ Approaching Vehicle Perception Results

— ICE1 — ICE2 — HV (EV mode)



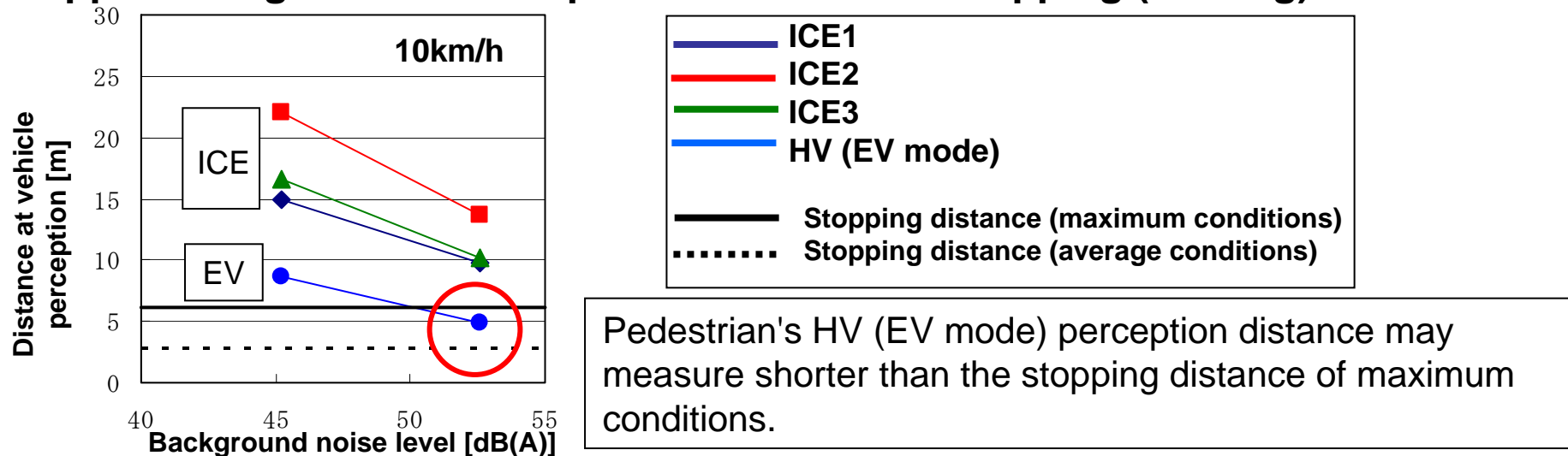
Background noise level [dB(A)]

● Perception of HV (EV mode) is lower than ICE when the background noise level is low and the speed is 15 km/h or below.

● The noise level difference became smaller as the vehicle speed exceeded 20 km/h.

# Background (4)

## ◆ Approaching Vehicle Perception Distance and Stopping (braking) Distance



The stop distance or vehicles was calculated from the following theoretical formulas and test results.

### 1. Calculation of Stop Distance.

$$\begin{aligned} \text{Stop distance} &= \text{free running distance} + \text{braking distance} \\ &= \text{speed} \times \text{reaction time} + \frac{\text{speed}^2}{2 \times 9.8 \times \text{coefficient of friction}} \end{aligned}$$

### 2. Free running distance (speed x reaction time).

The running-out reaction time test result in a public road .  
(Japan Safe Driving Center carried out in 2000)

Reaction time: Average = 0.82 (second), an average of +3sigma = 1.966 (second)

### 3. Braking Distance

$$\text{Braking distance} = \frac{\text{speed}^2}{2 \times 9.8 \times \text{coefficient of friction}}$$

A coefficient of friction is the following (from Ichiro Emori "automobile accident engineering").

- It is 0.6 in case of the worn-out tire on dry asphalt

- With the ordinary tire on dry asphalt, it is 0.7.

# MLIT activates for issue of quiet vehicles

- Japan federation of the blind and vehicle users demanded to take some measures against the quietness of these vehicles.
- This issue was discussed at the Diet.
- ➔ It is required immediately by the social demand to take measures of those vehicles as soon as possible.

**MLIT set up “Study Committee” on the quietness of HVs, in 2009.**

- The Study Committee decided to emit a sound from vehicles as a realistic measure for visually-handicapped people .
- At the end of January 2010, the Study Committee summed up the conclusions of discussions and reported it to MLIT.  
(Committee Report)
- MLIT published a proposed solution based on the Committee Report. (Guideline)
- The Guideline stats the requirements of **the Approaching Vehicle Audible Systems (AVAS).**

# AVAS in Japanese Regulation

		Audible warning devices (R28)	Sound emission (back and turn left)	Sound emission (forward movement)
Before released the Guideline	All vehicles	Mandatory	Optional	Not allowed
After released the Guideline	Other vehicles	Mandatory	AVAS defied in the Guideline	
	Vehicles can run only on electric motors (New category)	Mandatory	$0 < V \leq 20$ Voluntary	$0 < V \leq 20$ Voluntary

# Scope

**AVAS shall be installed in “Hybrid vehicles that can run only on electric motors”, “Electric vehicles” and “Fuel-cell vehicles”.**

**The point at issue : Which types of vehicles are needed measures.**

**Discussion of the issue:**

**Following vehicles were assumed to require measures against quietness.**

- (a) HVs with EV-mode and EVs**
- (b) HVs without EV-mode**
- (c) ICEVs with idling stop system**
- (d) Quiet general ICEVs**

- At Workshop, ICEVs were noticed by most participants even when it run at low speed.**
- (b) HVs without EV-mode (ex. Honda Insight) was found to be as noticeable as ICEV by the Workshop, because the engine is activated at the start.**

**Conclusion of the issue:**

- ◆ AVAS shall be installed in “Hybrid vehicles that can run only on electric motors”, “Electric vehicles” and “Fuel-cell vehicles”.**



# Scope

Discussion of the issue of scope : Reasons for eliminating vehicles with idling stop system.

- HV (Honda Insight), unable to run in an EV mode, has a structure which starts engine when it begins moving, the same as that of ICEVs with idling stop system. The verification of startup awareness of this vehicle at the workshop indicated 39 out of 40 people had noticed it.
- There were comments from visually impaired people, saying it rather was easier to distinguish at the startup.



# Scope

Discussions of the issue of scope: Why are ICEVs excepted from installation of AVAS.

- At the Workshop, 39 people of all participants (40 people) noticed the vehicle approaching of ICEV (TOYOTA Corolla) which was running at 10km/h. (a)



# Scope

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**Discussions of the issue of scope: Why are ICEVs excepted from installation of AVAS.**

- **At a low speed, the difference of sound pressure levels between HV and ICEV became large. The difference of sound pressure level reached a maximum at 20 dB when the vehicles were stationary. (Background (2))**
- **Pedestrian's perception distance of ICEV at low speed is longer than the stopping distance of vehicles. (Background (3))**

# Scope

**AVAS shall be installed in “Hybrid vehicles that can run only on electric motors”, “Electric vehicles” and “Fuel-cell vehicles”.**

**The point at issue : Which types of vehicles are needed measures.**

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**Following vehicles were assumed to require measures against quietness.**

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- At Workshop, ICEVs were noticed by most participants even when it run at low speed.**
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**Conclusion of the issue:**

- ◆ AVAS shall be installed in “Hybrid vehicles that can run only on electric motors”, “Electric vehicles” and “Fuel-cell vehicles”.**

# Activation Conditions (1)-1

## (1) Method of sound generation

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

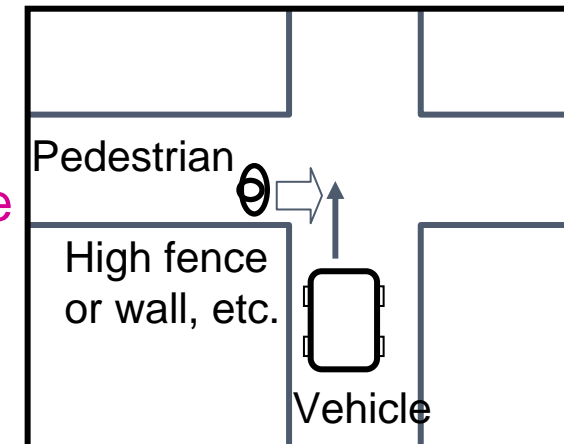
## The point at issue of (1)-1 : Means of sound emission

### Discussion of the issue:

- Manual emission by drivers; not effective.  
Neither drivers nor pedestrians notice the presence each other at crossings with poor visibility.

### Conclusion of the issue:

- ◆ System should automatically generate a sound.





# Activation Conditions (1)-2

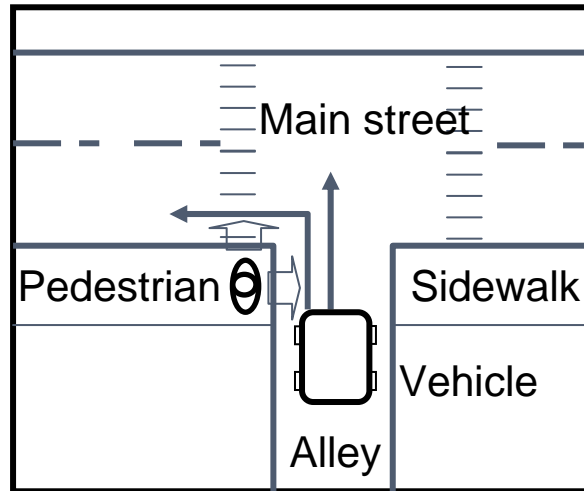
## (1) Method of sound generation

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

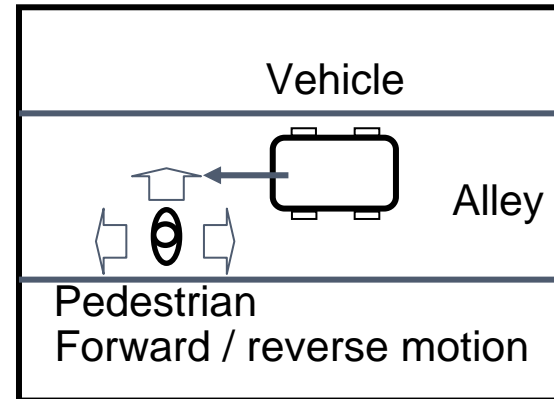
## The point at issue of (1)-2 :Vehicle speed when need sound emission Discussions of the issue of (1)-2:

- According to experiences of visually-handicapped people, the quietness became a problem when a vehicle moves from stopping and runs in a low speed. (a), (b)
- The difference of noise level between HV (EV mode) and ICEVs is small over 20km/h as shown (c)
- At Workshop, most of people noticed the approaching vehicle when 25km/h. (d)
- The noise level difference between ICEV and HE in EV mode became smaller as the vehicle speed exceeded 20 km/h. (Background(3))

# Activation Conditions (1)-2



(a) When a vehicle moves from stopping.



(b) When a vehicle is running in a low speed.

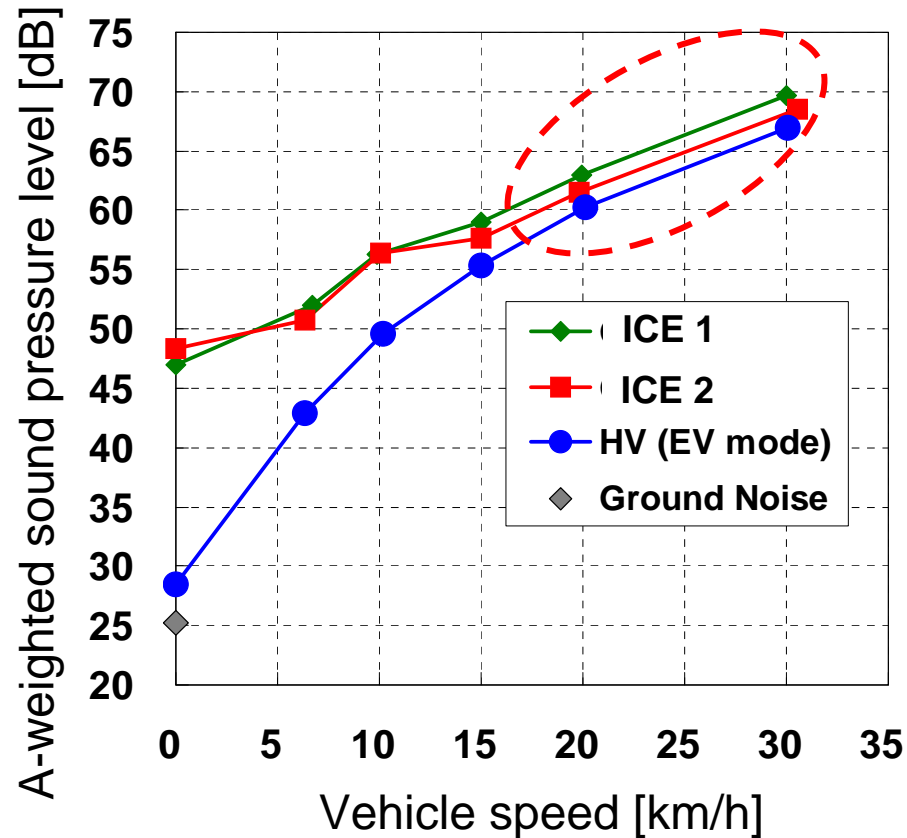
- According to experiences of blind or visually handicapped people, the quietness became a problem above situations (a) and (b).

(a) When a vehicle moves from stopping.

(b) When a vehicle is running in a low speed.

◆ Required at stop and low speed range and reverses motion

# Activation Conditions (1)-2



(c) Comparison of sound pressure levels between HV (EV mode) and ICEs.

● The difference of noise level between HV (EV mode) and ICEVs is small over 20km/h as shown (c)

◆ Not needed over 20km/h



# Activation Conditions (1)-2



(d) Scene of the workshop

- At the Workshop, most of participants noticed approaching vehicles which were running at 25km/h.  
(ICEV: Notices people 39/ All participants 40, Prius:38/48, Insight:39/40, iMiEV:37/49,)

# Activation Conditions (1)-2

## (1) Method of sound generation

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

## The point at issue of (1)-2 :Vehicle speed when need sound emission Discussions of the issue of (1)-2:

- According to experiences of visually-handicapped people, the quietness became a problem when a vehicle moves from stopping and runs in a low speed. (a), (b)
- The difference of noise level between HV (EV mode) and ICEVs is small over 20km/h as shown (c)
- At Workshop, most of people noticed the approaching vehicle when 25km/h. (d)
- The noise level difference between ICEV and HE in EV mode became smaller as the vehicle speed exceeded 20 km/h. (Background(3))

# Activation Conditions (1)-3

## (1) Method of sound generation

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

The point at issue of (1)-3 : Reasons for excluding sound generating function at a vehicle stop, and eliminating idling reduction vehicles.

- No need for sound-generating as, at a vehicle stop, it is equally interpreted in terms of noise level at the vehicles parked and stopped.
- During idling time, it is the same situation in noise as general ICEVs stop engine to a halt, and there is no need for special measures with HV and like such.
- Hybrid vehicles and like such are able to transmit their startup as AVAS installed generates sound at an engine start.

# Activation Conditions (2)

## (2) Pause Switch

Approaching Vehicle Audible Systems may be equipped with a mechanism to temporarily halt the operation of the system (hereinafter, the “Pause Switch”).

The point at issue : Why is the Pause Switch required?

### Discussions of the issue:

- Some drivers may increase a speed of vehicles in order not to emit a sound of AVAS.
- Any users might tamper the AVAS in order not to emit a sound.
- It is considered that a sound of AVAS is unnecessary in expressways or motorways that there is no pedestrians.
- However, the system should be so designed as not to remain in a pause condition, so it will need further consideration including how long it should take before recovery.

# Types and Volume of Sound Generation (1)

- A) The sound shall be continuous sound associating motor vehicles running condition.**
- B) Siren, chime, bells, melody, horn sound, animals, insects, and sound of natural phenomenon such as wave, wind, river current, etc are not allowed.**
- C) 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.**
- D) Sound volume shall not exceed a level of the sound generated when vehicles driven by internal combustion only run at speed of 20km/h.**

# Types and Volume of Sound Generation (2)

- A) The sound shall be continuous sound associating motor vehicles running condition.**
- B) Siren, chime, bells, melody, horn sound, animals, insects, and sound of natural phenomenon such as wave, wind, river current, etc are not allowed.**

## The point at issue : Type of sound

### Discussion of the issue:

Following sound were discussed as AVAS sound

- (a) Chime, (b) Melody, (c) Single tone,
- (d) Sound simulating running vehicles (e.g. engine sound, simulated motor sound)
- From the result of the Workshop, participants could hear and notice all these sounds from quiet vehicles as well or better than ICEV.
- But for visually-handicapped people, vehicle's presence and behavior (ex. approaching and departing) should be perceived naturally and effortlessly.

### Conclusion of the issue:

- ◆ Sound simulating vehicles running condition



# Types and Volume of Sound Generation (3)

**C) 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.**

**The point at issue : Reason for speed-sensitive sound volume**

**Discussion of the issue:**

- For visually-handicapped people, vehicle's presence and behavior (ex. approaching and departing) should be perceived naturally and effortlessly.
- It needs to be sufficient level of AVAS sound for the pedestrians including blind or visually handicapped people to perceive not only approaching or departing vehicles but also accelerating or decelerating.

**Conclusion of the issue:**

- ◆ **Volume and frequency shall be varied according to vehicle speed.**

# Types and Volume of Sound Generation (4)

**D) Sound volume shall not exceed a level of the sound generated when vehicles driven by internal combustion only run at speed of 20km/h.**

**The point at issue : Volume of the sound**

## **Discussion of the issue:**

- The sound of volume is required to be so intended that the pedestrian is as discernible as with the case of gasoline engine vehicle.
- On the other hand, a bad impact to environmental noise should be avoided in case of the vehicles with sound-generating function incorporated prevalent in high volumes, which points out a necessary guide-line that a noise level in the measure-required speed range is to be less than that of the gasoline engine vehicle at normal running condition.

## **Conclusion of the issue:**

- ◆ Volume is around the same as general ICEVs.



# Measures for penetration among vehicles in-use

**In light of quick penetration among vehicles in use, a sound generation device which does not meet every requirement for Approaching Vehicle Audible Systems but at least meets requirements of (A), (B), and (D) in the slide of p.21 may be installed as simplified systems. (The sound shall be generated continuously for 5 seconds or longer.)**

**The point at issue : Justification for the approach to add-on devices**

## **Discussion of the issue:**

- The add-on devices has been approved for the purpose of accelerated prevalence of AVAS.
- Substantial reason for the 5 second rule: It was so decided, thinking as it takes, at least, more than 5 seconds for pedestrians to grasp the movements of vehicle .(approaching, departing, accelerating, decelerating and whatsoever) It is the basic way of thinking that the sound should be generated continuously.

# Future activates (1)

**This time guideline's positional relation to the Regulation in force and the concept of its standardization in future.**

- Seeing to the issues over the present status and the penetration rate of HIV, triggered the necessity to go up for enabling a quick action to strike out counter-measures, resulting in the guideline summarized from considerations.
- Before it goes to mandatory installation of AVAS on the new vehicle, verification of social acceptability, setting-up of regulation figures based on a prospective of technological development, organization of a testing method, and the consideration of timing for the mandatory installation are needed. However, regarding the vehicles already developed and on sale at the moment, it needs to be considered with alteration of the existing structural layout and/or the fabrication process taken into account. Therefore, at present, the standardization of AVAS installation has been passed on to next possible opportunity.
- From now on, the standardization process is scheduled to start, in accordance with the verification of technological and social acceptability and other related matters.(AVAS-installed new cars will be commercially available at the end of the year, and the standardization will wait and watch out the outcome of market response.)

# Future activates (2)

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## Judgment criteria of the sound associating the vehicle

- As the vehicle-associating sound such as quasi-engine sounds is highly likely going to be developed based on their own vehicle sounds, the judgment for adoption is to be made by them.

## As with new technologies other than sound

- Among comments and opinions sent to MLIT, there was a proposal of how about applying to the measures concerning “Quietness” the technology to inform the pedestrians of vehicles approaching, and vice versa, by making use of communication technology as well as sensor technology. Those technologies, having a merit that there is no concern about losing acceptability to inhabitants and drivers owing to the sound generated from the vehicle which has turned out to be an imperative issue in the recent consideration, still possesses many technological issues preventing the technologies from coming soon into realization. It is highly expected to proceed with technological developments as an effective measure ahead.

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Thank you for your attention!