



A study of AVAS on the QRTV

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Study directions

◎ Assume the proper sound pressure levels of the AVAS

1. Test results at constant mode & acceleration mode

Outdoor (Road) & Indoor (Chamber)

2. The test results of the background noise

3. Is it appropriate to do testing in constant speed mode only?

4. Is the tested speed range from 0 ~ 20km/h sufficient?

5. Others

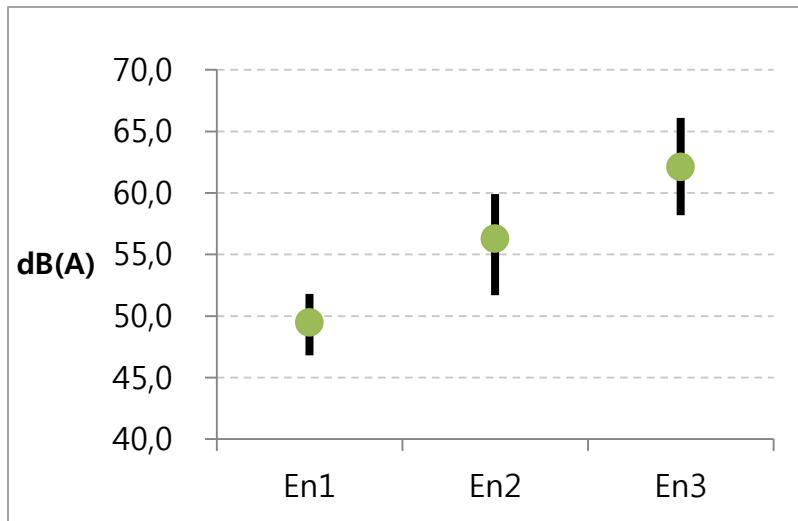
One-lane street around residential area



Background noise test

dB(A)

section	section	area	Mean	Japan
En1	Quiet street	Apartment, residential area	49.5	44.0
En2	Middle level street	Shared space street depart from main street	56.3	54.8
EN3	Loud street	crosswalk nearby main street	62.1	60.3



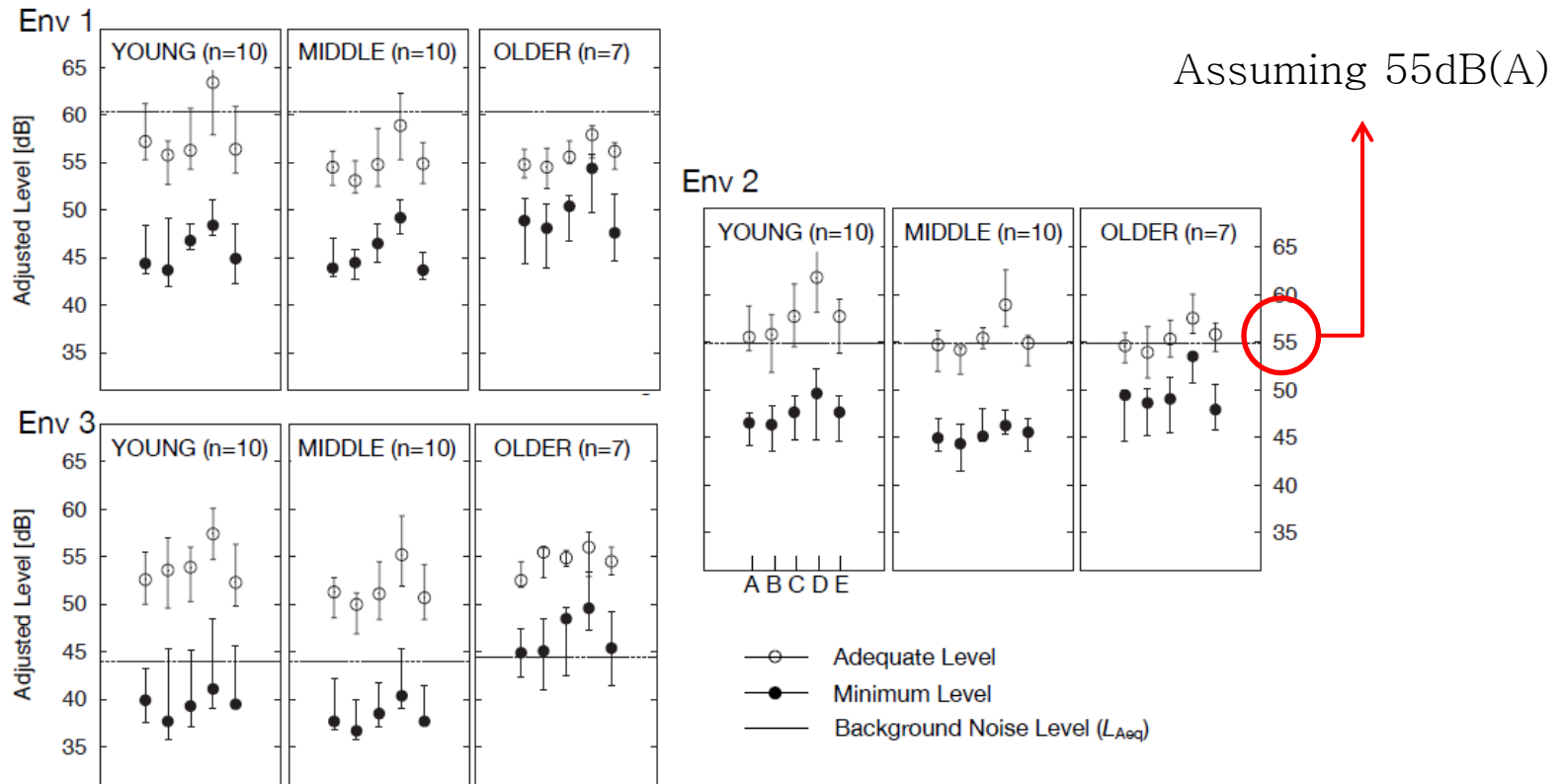
Reference

◎ NHTSA research

Assumptions:

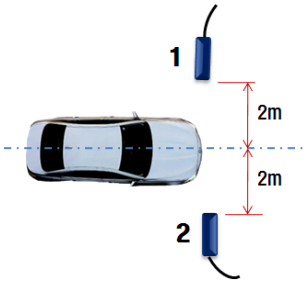


- A vehicle should be detectable on a moderate suburban ambient (55 dB(A))

◎ Japan research(Katsuya Yamauchi)



Test setup

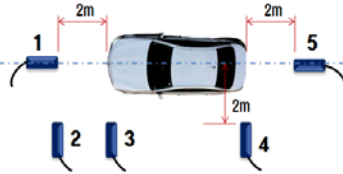


Test track-Road

setup	A vehicle	B vehicle
		

A vehicle $\begin{cases} \text{EV} \\ \text{ICEV} \end{cases}$

B vehicle $\begin{cases} \text{EV} \\ \text{ICEV} \end{cases}$

Anechoic chamber

setup	A vehicle	B vehicle
		

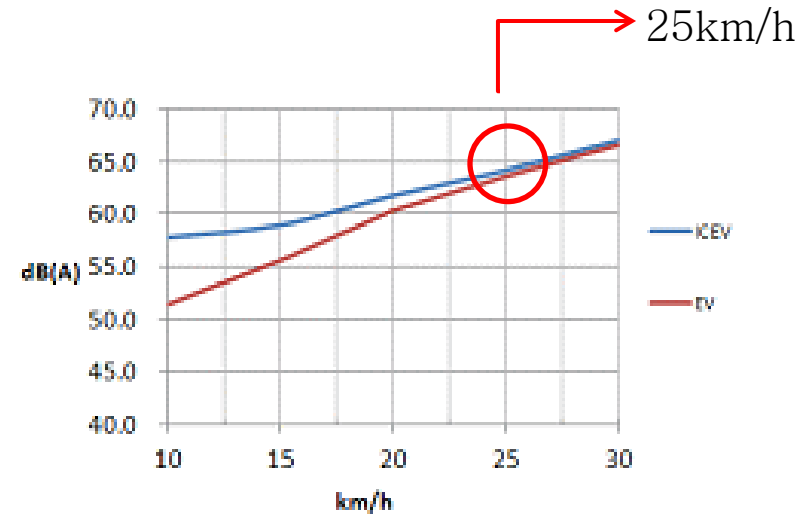
Constant speed test results on the road



A-Vehicle(Road)

dB(A)

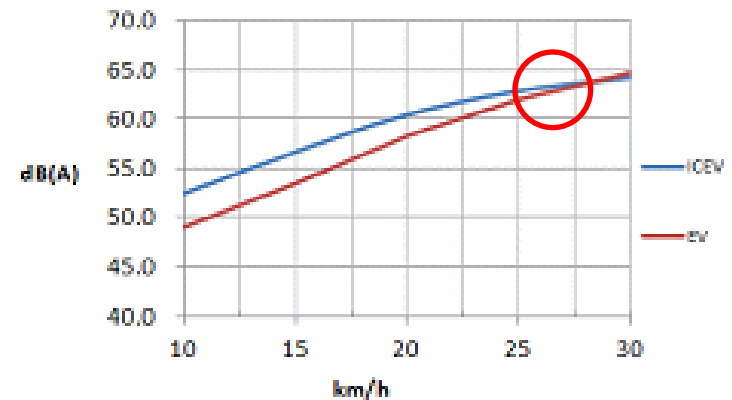
V (km/h)	EV	ICEV	Difference	Generate
10	49.0	56.8	7.8	56.0
15	53.5	57.7	4.2	55.6
20	58.3	61.7	3.4	59.0
25	62.0	63.8	1.8	59.1
30	64.7	65.8	1.1	59.3



B-Vehicle(Road)

dB(A)

V (km/h)	EV	ICEV	Difference	Generate
10	51.4	57.8	6.4	56.7
15	55.7	58.9	3.2	56.1
20	60.3	61.8	1.5	56.5
25	63.7	64.2	0.5	54.6
30	66.7	67.1	0.4	56.5



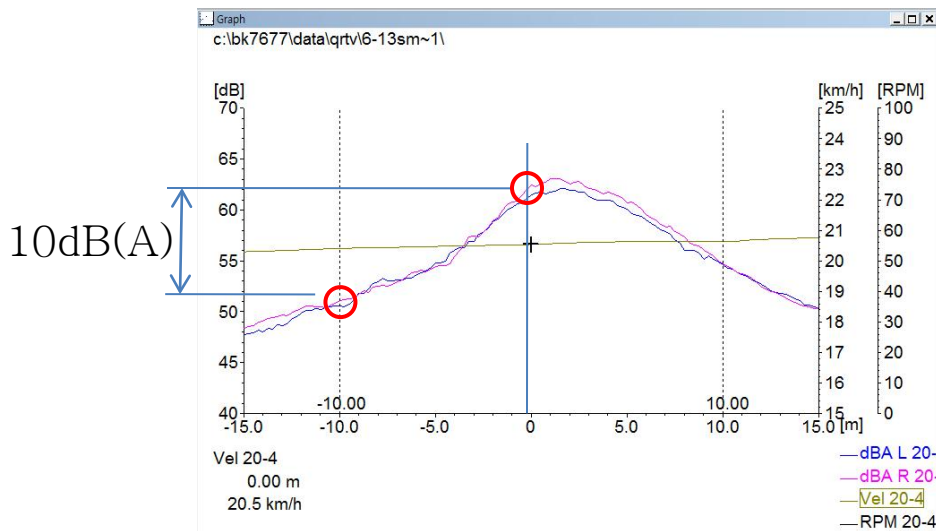
Constant speed test results



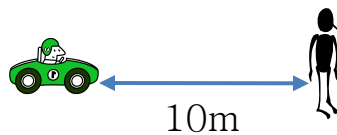
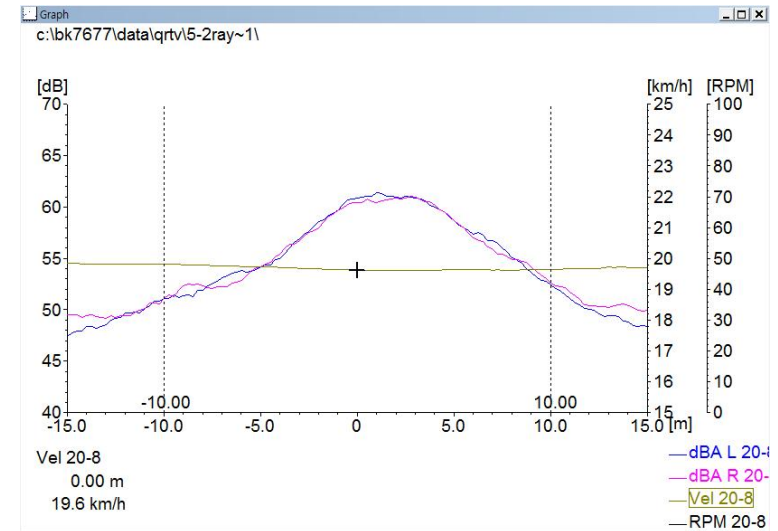
Test speed is 20km/h

- Vehicle stopping distance
= driver reaction distance(R) + vehicle braking distance(B)
here R(meter) = [vehicle speed(km/h) / 10] × 3
B(meter) = [vehicle speed(km/h) / 10]²
ex) 10m at 20km/h (Suppose 10m is the perceivable distance)

A-Vehicle



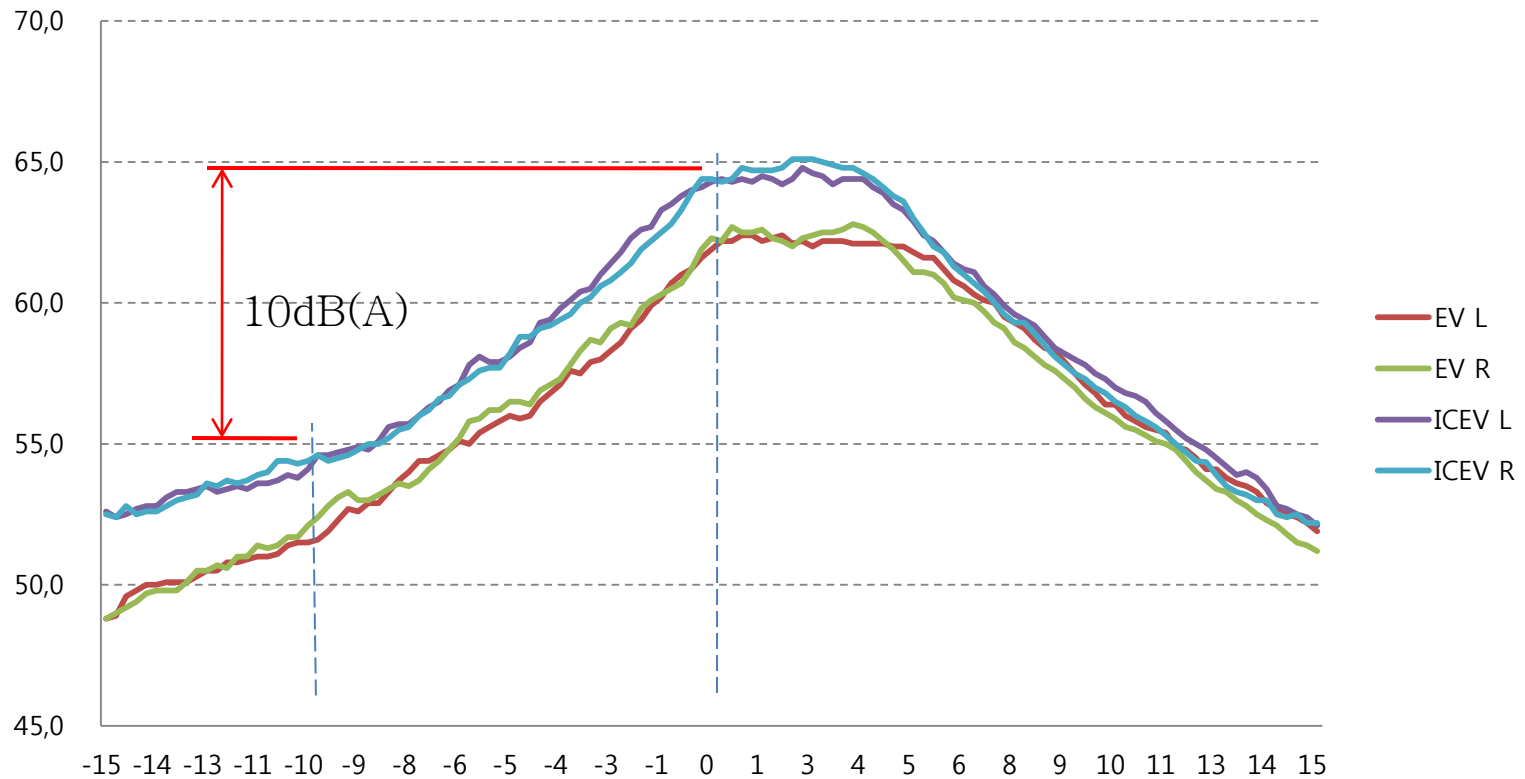
B-Vehicle



SPL at constant speed test mode on Road

Test speed is 25km/h

EV&ICEV SPL graph

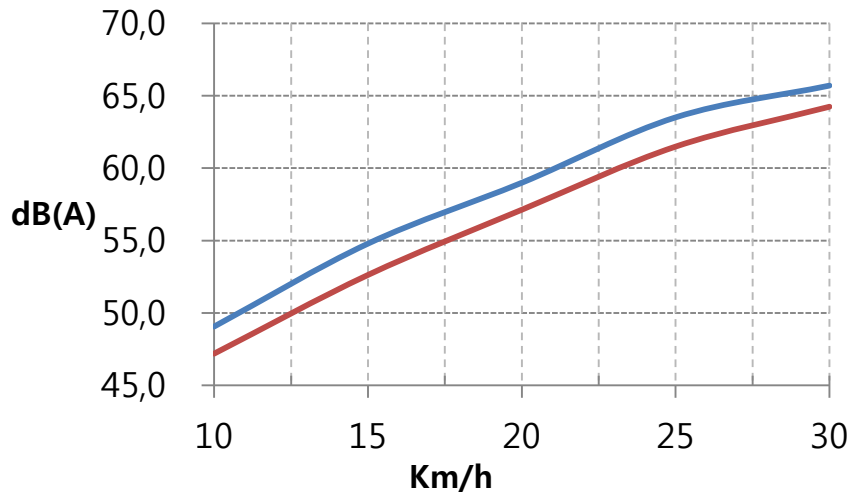


Constant speed & Acceleration test results in Chamber

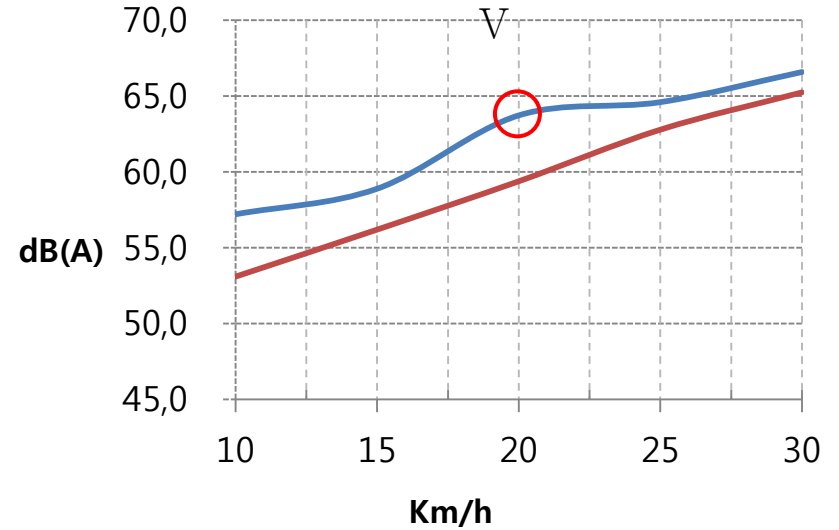


A-Vehicle

EV



ICE



- Acceleration mode
- Constant mode

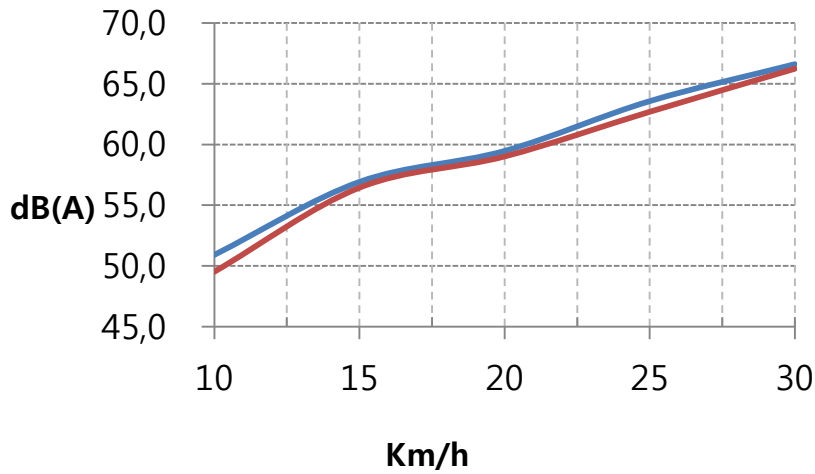
Constant speed & Acceleration test results in Chamber



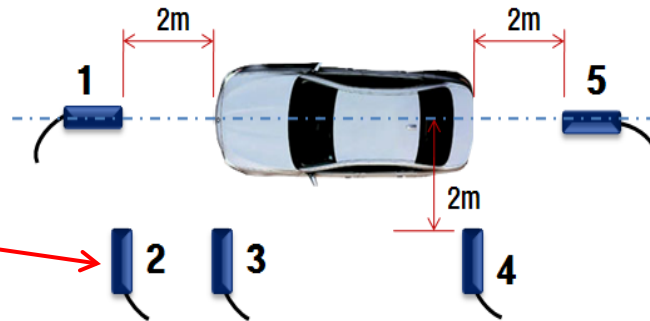
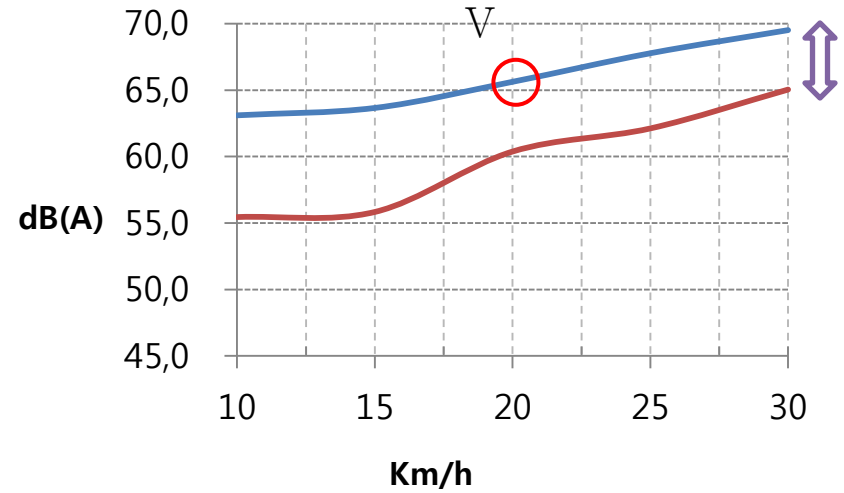
B-Vehicle

- Acceleration mode
- Constant mode

EV



ICE



Compared at 2nd microphone

Constant speed & Acceleration test results in Chamber

A-Vehicle(ICEV)

V (km/h)	Constant	Acceleration	Difference	Generate
10	52.5	57.2	4.7	55.4
15	55.5	59.0	3.5	56.4
20	58.6	63.4	4.8	61.7
25	62.3	64.1	1.8	59.4
30	64.5	66.2	1.7	61.3



Acceleration
is 0.5~0.6m/s²
55~61dB(A)

B-Vehicle(ICEV)

V (km/h)	Constant	Acceleration	Difference	Generate
10	55.4	62.5	7.1	61.6
15	55.8	63.7	7.9	62.9
20	60.4	65.6	5.2	64.0
25	62.1	67.8	5.7	66.4
30	65	69.5	4.5	67.6



Acceleration
is 0.2~0.5m/s²
61~67dB(A)

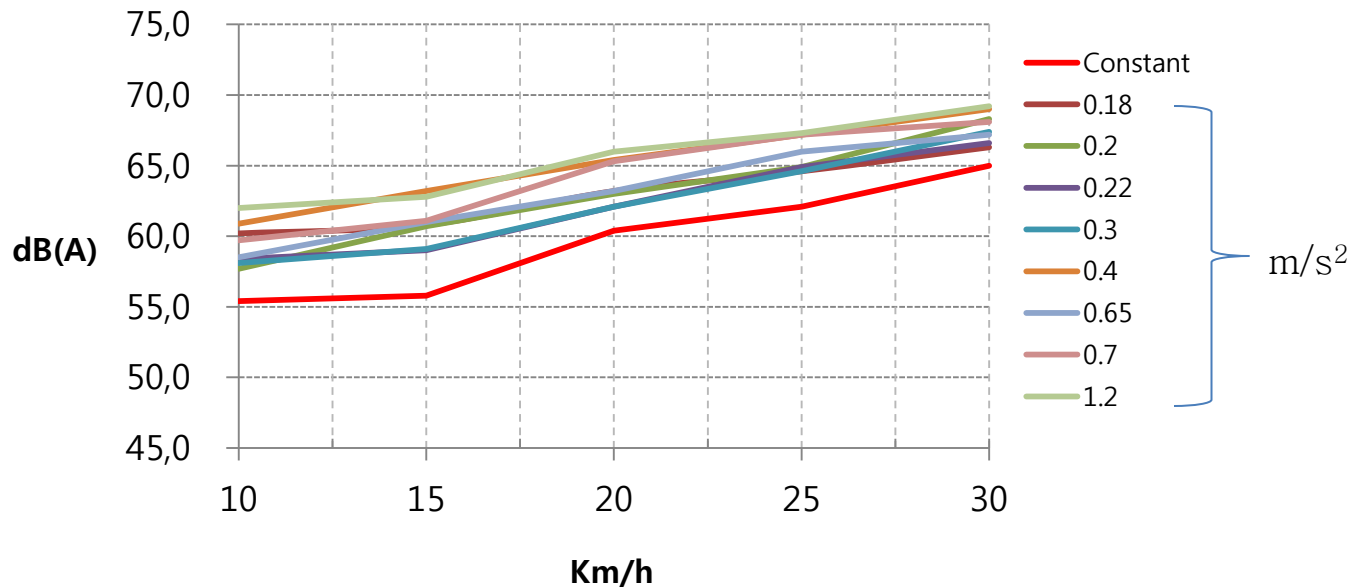
Difference between constant and acceleration mode

B-vehicle

◎ RPM at constant speed & acceleration mode

V(km/h)	constant		Difference
10	1,450	2,010	560
15	1,210	2,070	860
20	1,600	2,190	590
25	1,260	2,360	1,100
30	1,490	2,620	1,130

◎ Graph according to acceleration



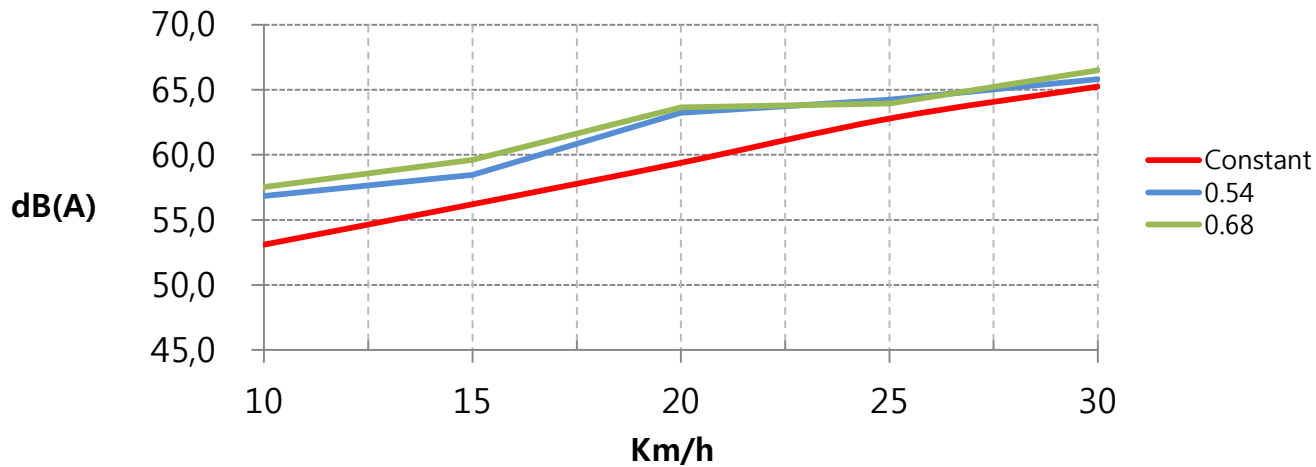
Difference between constant and acceleration mode

A-vehicle

◎ RPM at constant & acceleration speed mode

V(km/h)	constant	Accell	Difference
10	1,250	1,560	310
15	1,300	1,650	350
20	1,190	1,810	620
25	1,170	1,460	290
30	1,190	1,440	250

◎ Graph according to acceleration



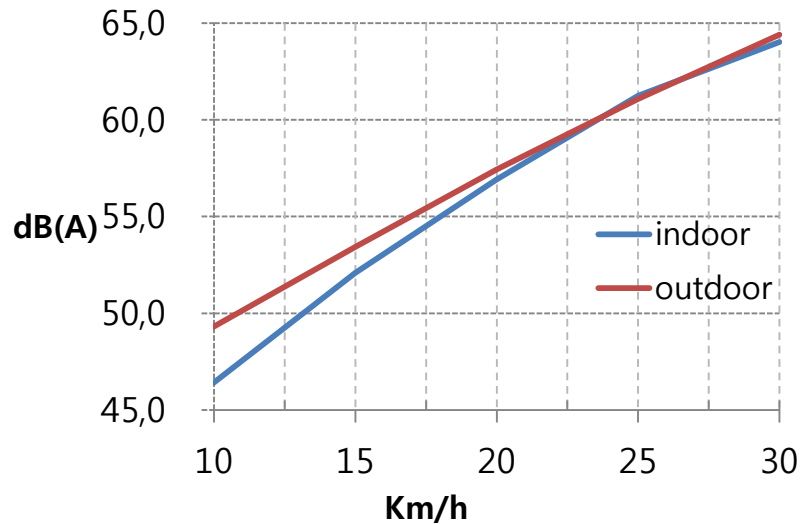
Test site

ISO/CD 16254 **7.1.5.5 Slow speed cruise** **7.1.5.5.1 General**

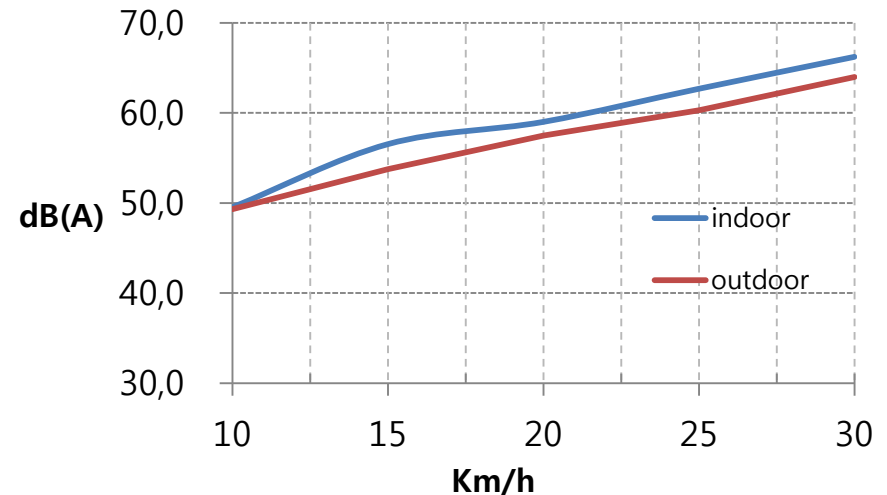
The test speed v_{test} shall be 10 km/h + 1 km/h between AA' and PP'. In the case of front engine vehicles, the test speed v_{test} may be 10 km/h ± 1 km/h between AA' and BB'.

If a vehicle is tested in an indoor facility, the vehicle shall be located with the front or rear reference point on the PP' line.

EV A-vehicle



EV B-vehicle



Difference of SPL according to acceleration

7.2.4 Frequency shift measurement test procedure

7.2.4.3 Vehicle test procedure

7.2.4.3.1 Full vehicle operation

The vehicle shall be installed in an indoor test facility where the vehicle can operate in the same manner as outdoors. The test facility shall meet all acoustic requirements as specified in this International Standard and shall have the capability to simulate actual road load input to the vehicle. All microphone locations shall be as for the full vehicle test conditions.

- It can be also tested on the road.
 - > because 20km/h is low ($20\text{km/h} = 5.5\text{m/s}$) and we only check the frequency shift not SPL.



Conclusion

1. It should be considered not only to cruise but also acceleration.
2. The necessary sound level of AVAS is 55~60dB(A) in cruise and 60~65dB(A) in acceleration. The acceleration considered is minimum.
3. 20km/h is too low as compared with ICEV.
4. The frequency shift measurement also can be conducted outdoor.

Thank you
for your attention!

