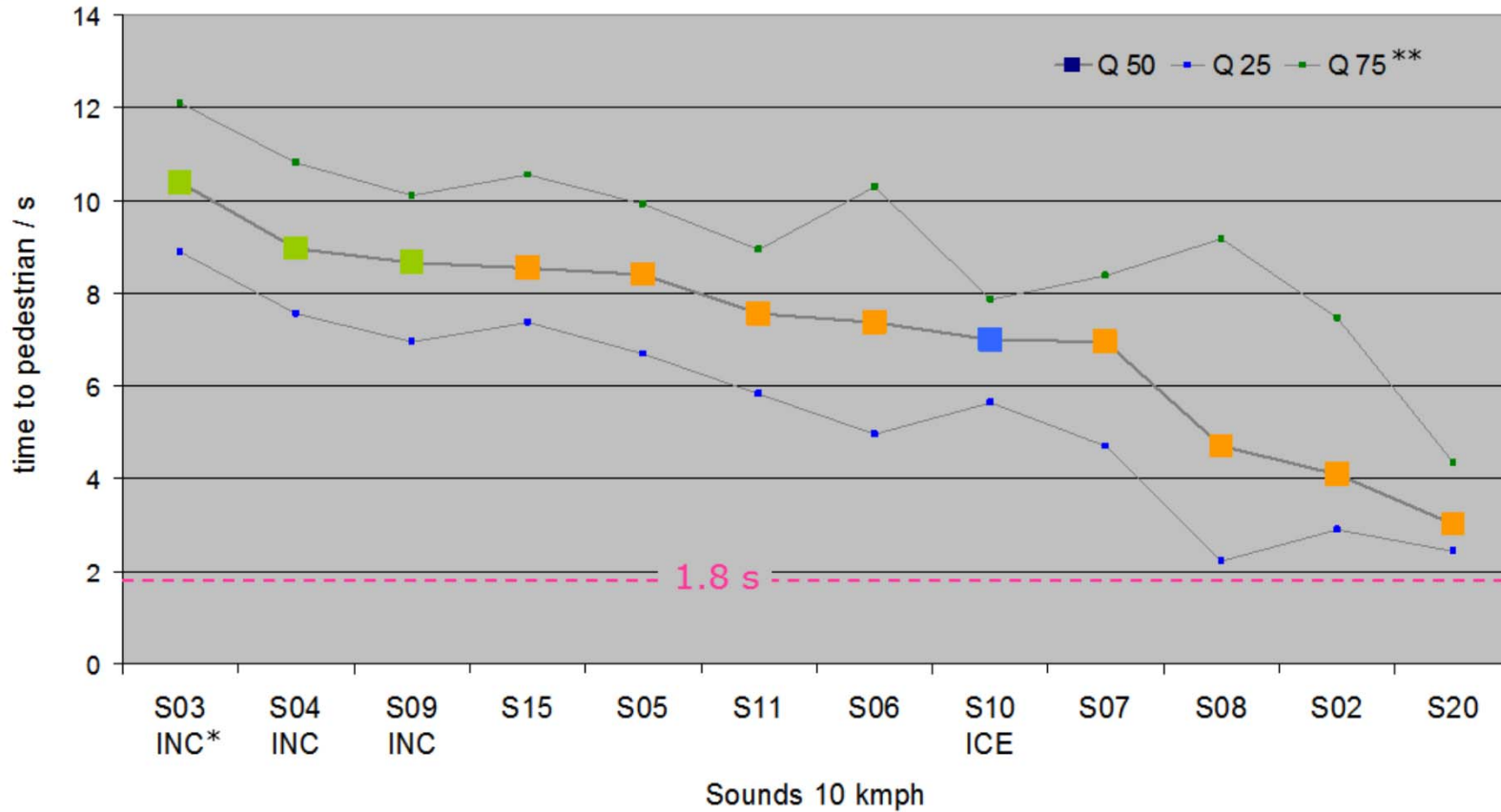


VDA

Verband der
Automobilindustrie

German Association of
the Automotive Industry

Hans-Martin Gerhard

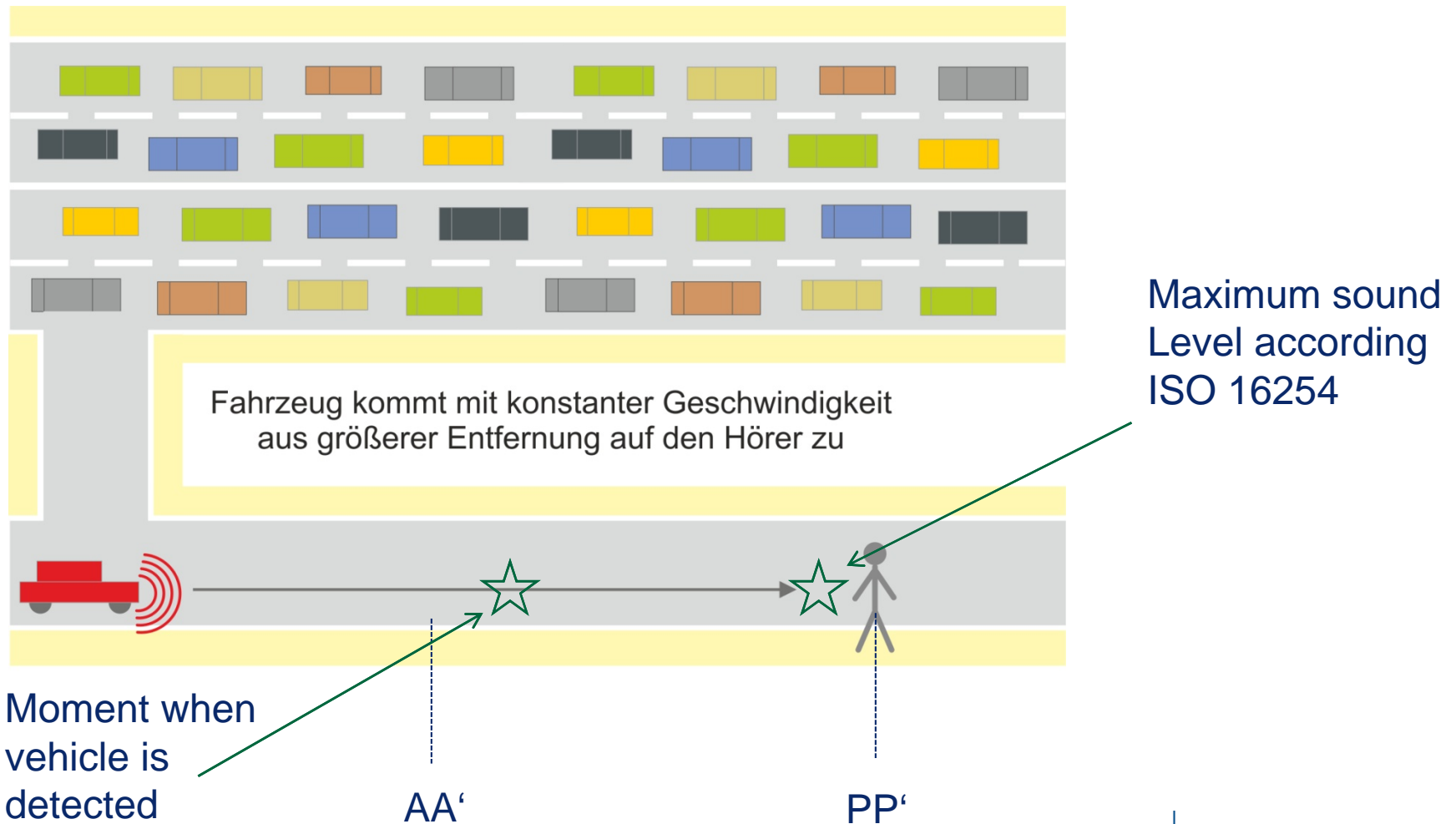


*INC = Intended NHTSA compliant, all others = Manufacturer's preferred sounds
 **Q50 = Median, Q25 = 25th percentile, Q75 = 75th percentile

4

Alle vehicles are sufficiently detectable !

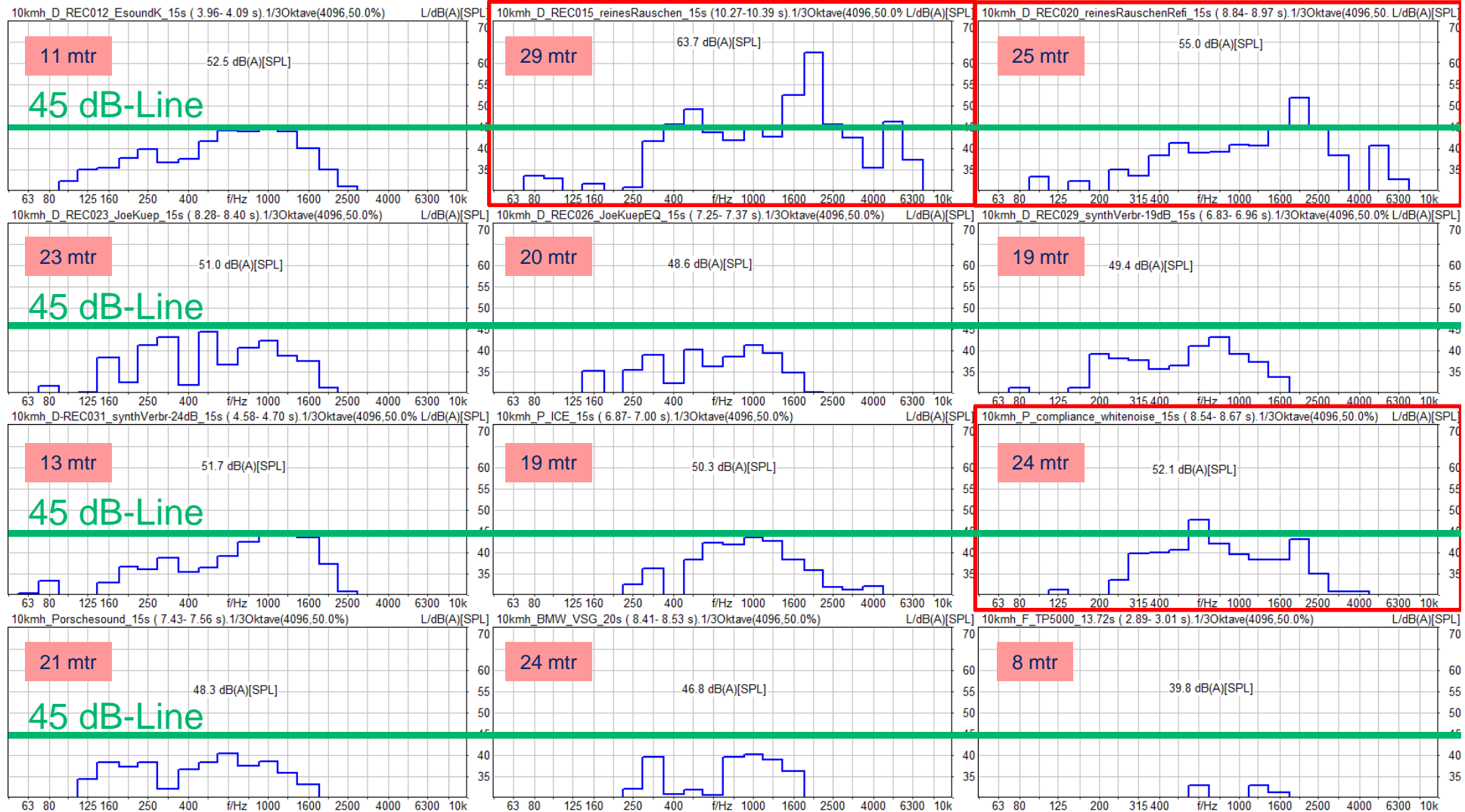
Reported Sound Levels during the approach of the vehicle



3rd Octave at the moment of detection

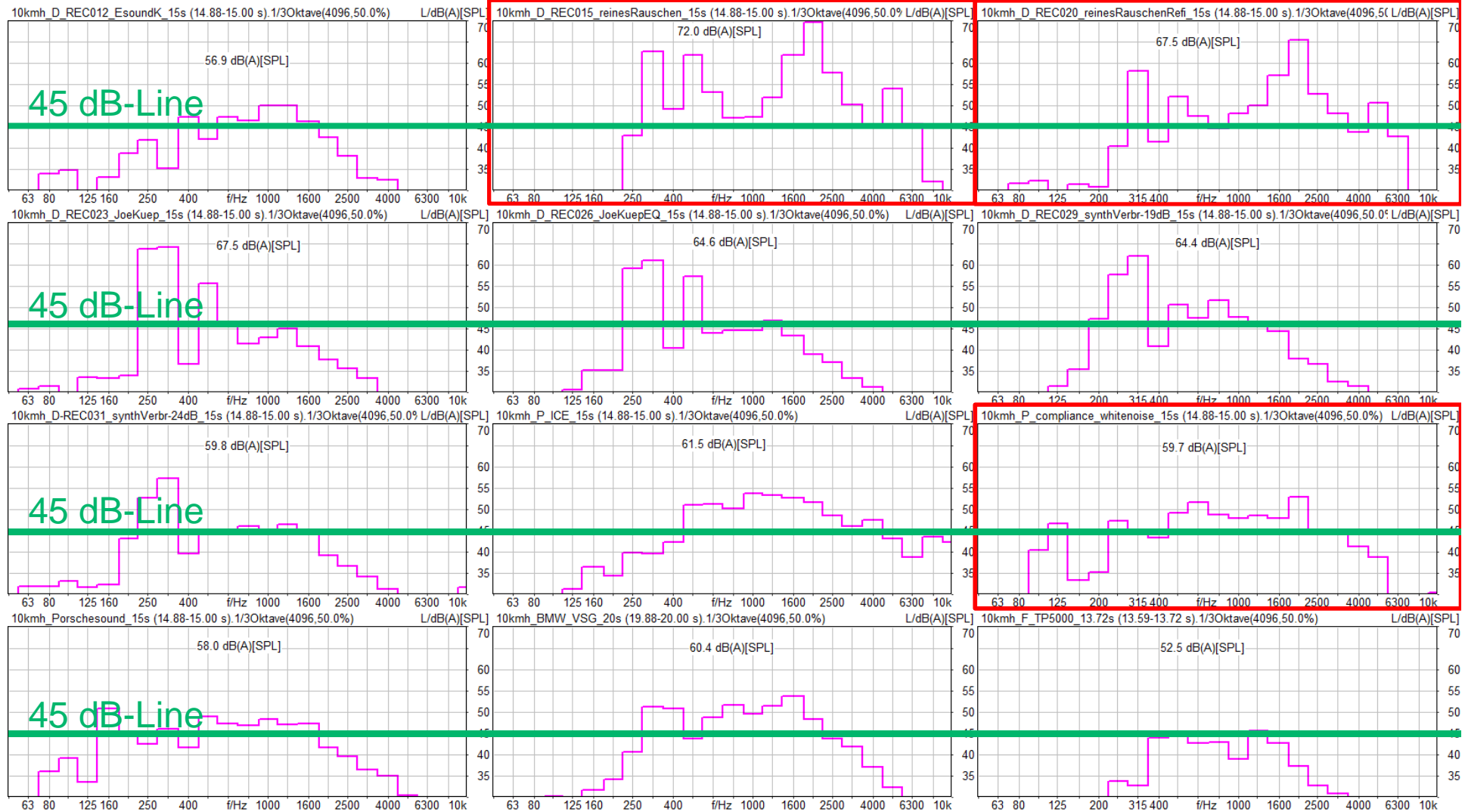
Point of Detection

  NHTSA Compliant



3rd Octave Spectra according Draft ISO 16254

  NHTSA Compliant



TUD Study 2013 Spectra Analysis (According ISO16254)

Check for VDA Concept Levels - Meet sound levels in 2 bands, one at least below 1600Hz

1/3rd Octave	VDA	S03 INC	S04 INC	S09 INC	S15	S05	S11	S06	S10 ICE	S07	S08	S02	S20
160	45	27,5	31,5	33,4	31,7	33,4	50,8	35,3	36,6	35,4	32,5	33,3	27,3
200	45	29,1	31,0	35,3	34,2	34,0	45,3	35,3	34,5	47,5	43,2	38,8	29,6
250	45	43,0	40,5	47,2	40,7	63,9	42,5	59,3	39,8	57,8	52,7	42,1	33,9
315	46	62,8	58,2	44,2	51,3	64,3	46,0	61,1	39,6	62,1	57,1	35,3	32,9
400	47	49,3	41,5	43,4	50,8	36,8	41,7	40,5	42,4	41,0	39,6	47,4	44,1
500	47	62,0	52,2	49,2	43,7	55,9	49,0	57,3	51,0	50,7	44,7	42,2	45,2
630	48	53,3	47,6	51,7	48,8	45,7	47,2	44,1	51,1	47,6	44,3	47,3	42,8
800	49	47,3	44,6	48,6	51,6	41,5	46,8	44,7	50,1	51,7	46,0	46,7	42,9
1.000	50	47,4	48,3	47,9	49,7	43,1	48,3	44,7	53,8	47,8	44,4	50,1	39,0
1.250	50	52,0	50,2	48,5	51,5	45,1	47,1	46,8	53,3	45,8	46,4	50,1	45,6
1.600	48	62,0	57,1	47,9	53,8	40,8	47,2	43,4	52,7	44,3	44,8	46,4	42,6
2.000	46	69,7	65,5	52,8	48,3	37,9	41,7	39,1	51,8	37,9	39,3	42,6	37,4
2.500	43	57,7	52,9	45,0	43,7	35,8	39,7	37,3	48,6	36,8	36,6	38,2	32,8
3.150	41	50,3	48,2	44,4	42,0	33,4	36,5	33,5	46,0	32,7	34,2	33,0	30,8
4.000	37	45,6	44,0	41,4	37,2	29,9	35,2	31,4	47,5	31,6	31,4	32,6	27,0
5.000	35	54,0	50,9	38,8	32,3	28,3	30,6	29,1	43,2	28,8	27,7	28,8	20,4

11 vehicles out of 12 can fulfill the specifications

TUD Study 2013 Spectra Analysis (According ISO16254)

Check for JAPAN Concept Levels - Meet sound levels in 2 bands, one above 1000Hz band and one below 800 Hz band.

1/3rd Octave	JAPAN		S03 INC	S04 INC	S09 INC	S15	S05	S11	S06	S10 ICE	S07	S08	S02	S20
160	43		27,5	31,5	33,4	31,7	33,4	50,8	35,3	36,6	35,4	32,5	33,3	27,3
200	43		29,1	31,0	35,3	34,2	34,0	45,3	35,3	34,5	47,5	43,2	38,8	29,6
250	43		43,0	40,5	47,2	40,7	63,9	42,5	59,3	39,8	57,8	52,7	42,1	33,9
315	43		62,8	58,2	44,2	51,3	64,3	46,0	61,1	39,6	62,1	57,1	35,3	32,9
400	43		49,3	41,5	43,4	50,8	36,8	41,7	40,5	42,4	41,0	39,6	47,4	44,1
500	43		62,0	52,2	49,2	43,7	55,9	49,0	57,3	51,0	50,7	44,7	42,2	45,2
630	43		53,3	47,6	51,7	48,8	45,7	47,2	44,1	51,1	47,6	44,3	47,3	42,8
800	43		47,3	44,6	48,6	51,6	41,5	46,8	44,7	50,1	51,7	46,0	46,7	42,9
1.000	999		47,4	48,3	47,9	49,7	43,1	48,3	44,7	53,8	47,8	44,4	50,1	39,0
1.250	43		52,0	50,2	48,5	51,5	45,1	47,1	46,8	53,3	45,8	46,4	50,1	45,6
1.600	43		62,0	57,1	47,9	53,8	40,8	47,2	43,4	52,7	44,3	44,8	46,4	42,6
2.000	43		69,7	65,5	52,8	48,3	37,9	41,7	39,1	51,8	37,9	39,3	42,6	37,4
2.500	43		57,7	52,9	45,0	43,7	35,8	39,7	37,3	48,6	36,8	36,6	38,2	32,8
3.150	43		50,3	48,2	44,4	42,0	33,4	36,5	33,5	46,0	32,7	34,2	33,0	30,8
4.000	43		45,6	44,0	41,4	37,2	29,9	35,2	31,4	47,5	31,6	31,4	32,6	27,0
5.000	43		54,0	50,9	38,8	32,3	28,3	30,6	29,1	43,2	28,8	27,7	28,8	20,4

All vehicles can fulfill the specifications

TUD Study 2013 Spectra Analysis (According ISO16254)

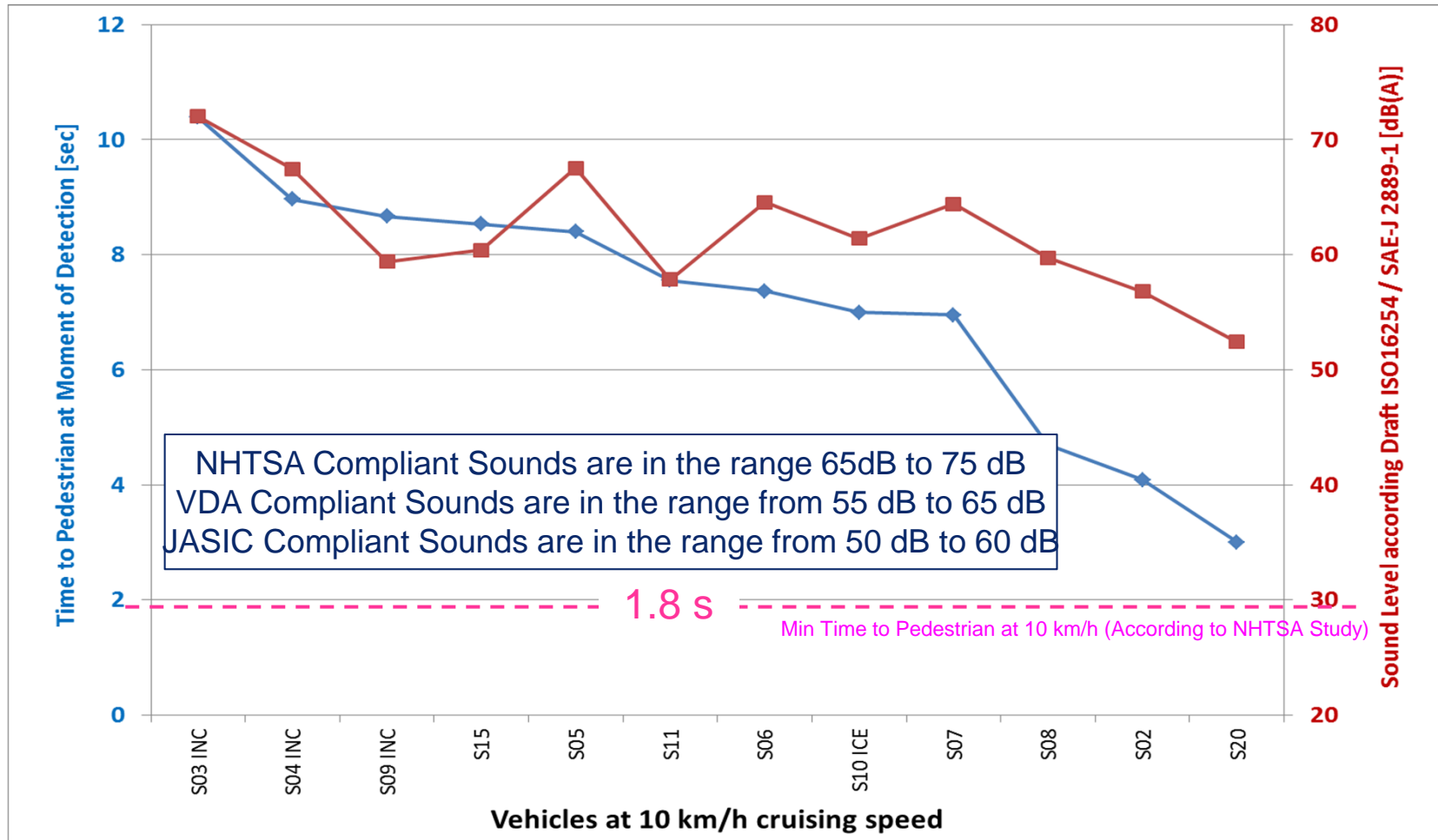
Check for USA Concept Levels - Meet sound levels in all 8 discrete bands

1/3rd Octave	NHTSA	S03 INC	S04 INC	S09 INC	S15	S05	S11	S06	S10 ICE	S07	S08	S02	S20
160	999	27,5	31,5	33,4	31,7	33,4	50,8	35,3	36,6	35,4	32,5	33,3	27,3
200	999	29,1	31,0	35,3	34,2	34,0	45,3	35,3	34,5	47,5	43,2	38,8	29,6
250	999	43,0	40,5	47,2	40,7	63,9	42,5	59,3	39,8	57,8	52,7	42,1	33,9
315	48	62,8	58,2	44,2	51,3	64,3	46,0	61,1	39,6	62,1	57,1	35,3	32,9
400	49	49,3	41,5	43,4	50,8	36,8	41,7	40,5	42,4	41,0	39,6	47,4	44,1
500	49	62,0	52,2	49,2	43,7	55,9	49,0	57,3	51,0	50,7	44,7	42,2	45,2
630	999	53,3	47,6	51,7	48,8	45,7	47,2	44,1	51,1	47,6	44,3	47,3	42,8
800	999	47,3	44,6	48,6	51,6	41,5	46,8	44,7	50,1	51,7	46,0	46,7	42,9
1.000	999	47,4	48,3	47,9	49,7	43,1	48,3	44,7	53,8	47,8	44,4	50,1	39,0
1.250	999	52,0	50,2	48,5	51,5	45,1	47,1	46,8	53,3	45,8	46,4	50,1	45,6
1.600	999	62,0	57,1	47,9	53,8	40,8	47,2	43,4	52,7	44,3	44,8	46,4	42,6
2.000	48	69,7	65,5	52,8	48,3	37,9	41,7	39,1	51,8	37,9	39,3	42,6	37,4
2.500	45	57,7	52,9	45,0	43,7	35,8	39,7	37,3	48,6	36,8	36,6	38,2	32,8
3.150	43	50,3	48,2	44,4	42,0	33,4	36,5	33,5	46,0	32,7	34,2	33,0	30,8
4.000	39	45,6	44,0	41,4	37,2	29,9	35,2	31,4	47,5	31,6	31,4	32,6	27,0
5.000	37	54,0	50,9	38,8	32,3	28,3	30,6	29,1	43,2	28,8	27,7	28,8	20,4

Vehicles that can fulfill the specifications: **one** of 12 vehicles
 Although 3 sounds have been designed to meet the NHTSA specifications !

TUD Study 2013

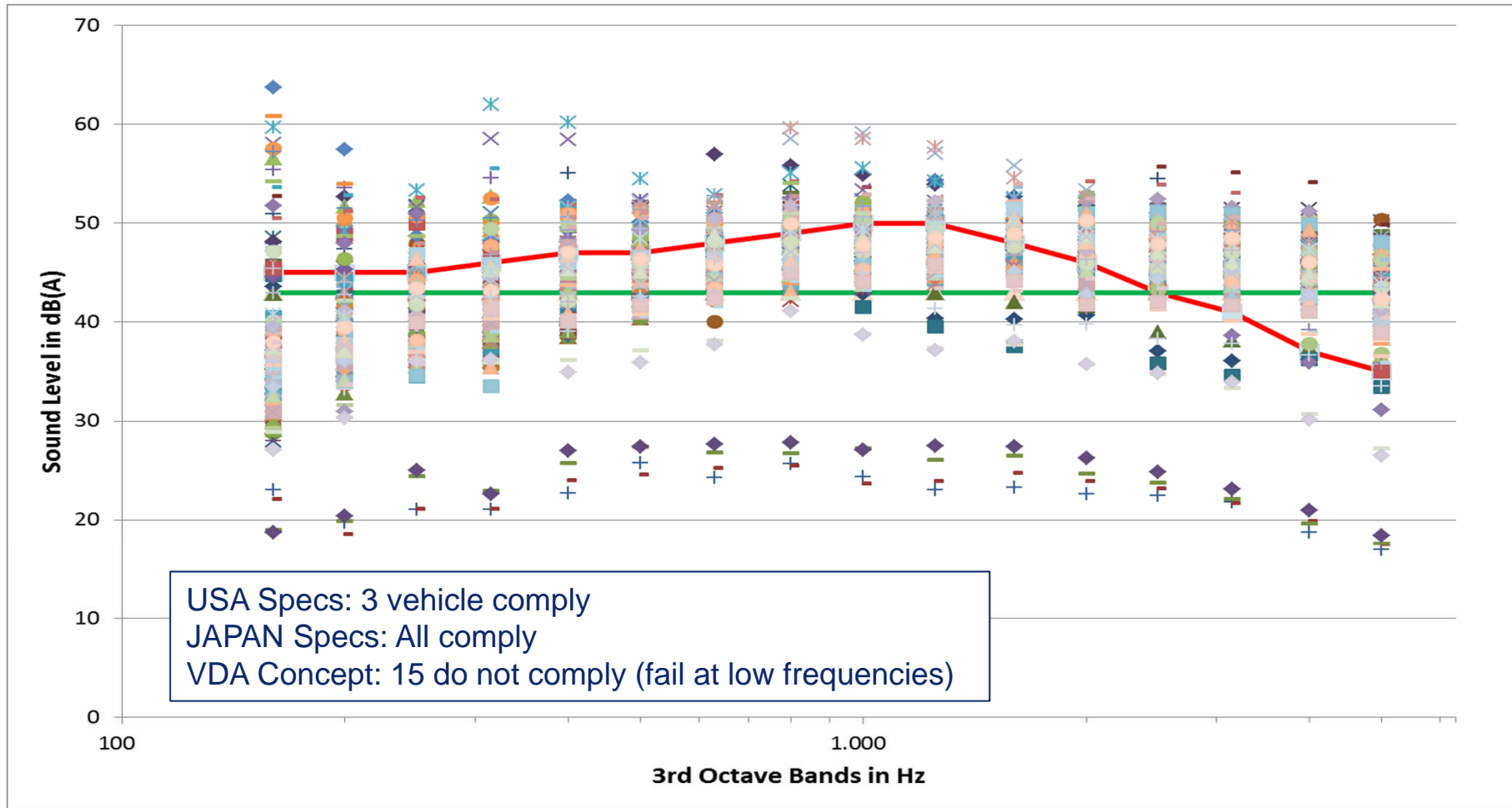
Detection Distances and Overall Sound Level (10 km/h Cruise-by)



Observations

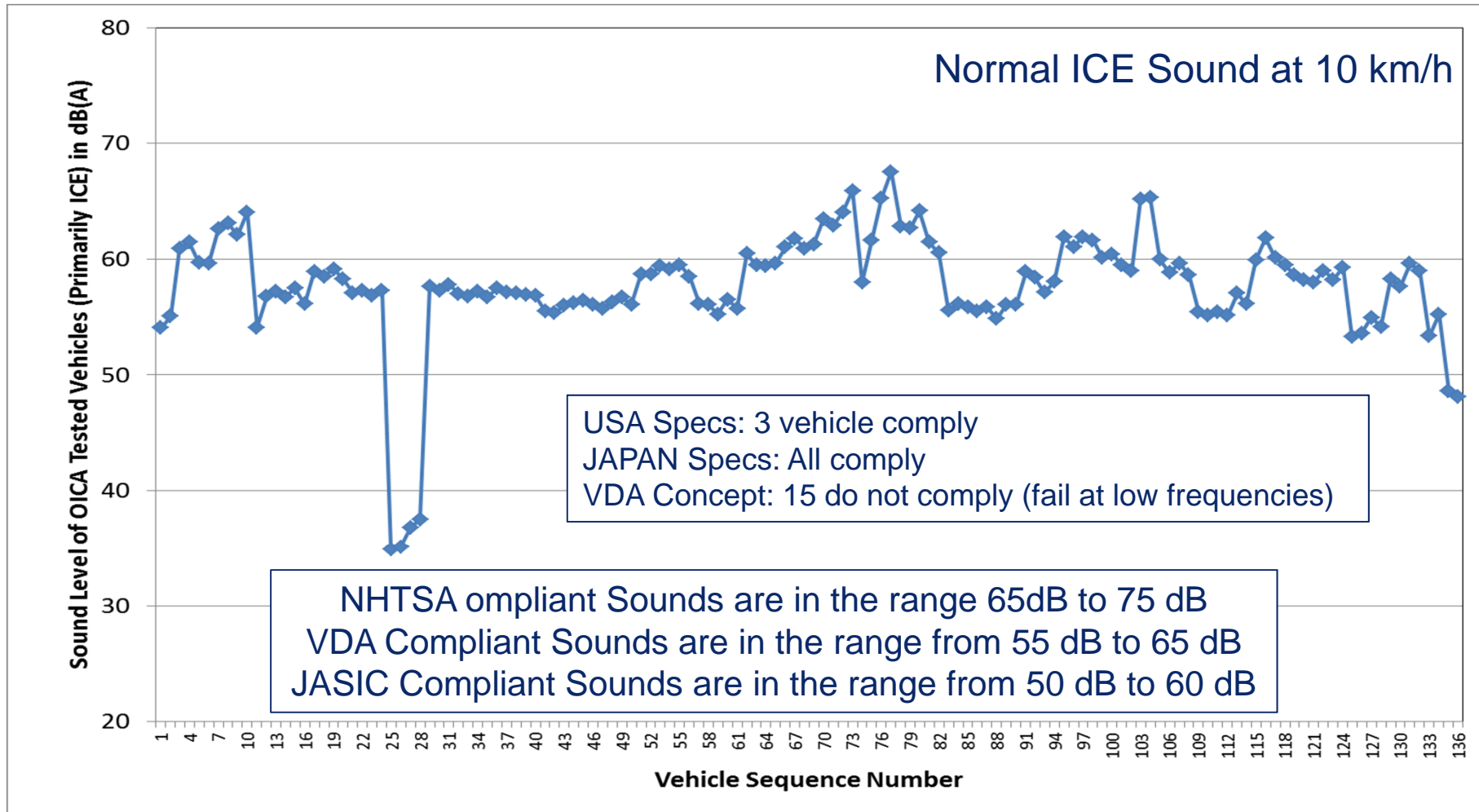
- Three sounds have been designed to meet the NHTSA criteria, but when tested only one of them could comply. Manufacturer will have to overshoot the minimum sound criteria in each band, to be on the safe side for compliance.
- The NHTSA Specifications will lead to overall sound levels of the vehicle which is higher than those of ordinary ICA vehicles of today. Traffic noise will go up.
- VDA levels tend to be unnecessary high for lower frequency bands and should be adjusted by maybe -2 dB(A) for the frequency range up to 1000 Hz.
- The Proposal of JAPAN will lead to vehicles that can be lower in overall sound emission compared to ICE vehicles today.
The JAPAN level tend to create the bottom line. If just reached the detection distance is approximately the NHTSA criteria for stopping or slightly higher.
- Manufacturer created sounds focus typically on a limited number of frequency bands, but often exceed the minimum sound levels, in some cases by more than 10 dB.
- Such sounds are easy to create and still often an identical good detectability.

ICE Vehicles at 10 km/h (OICA 2012 Data)



OICA Study 2012

Result of Sound level at 10km/h (6mph)



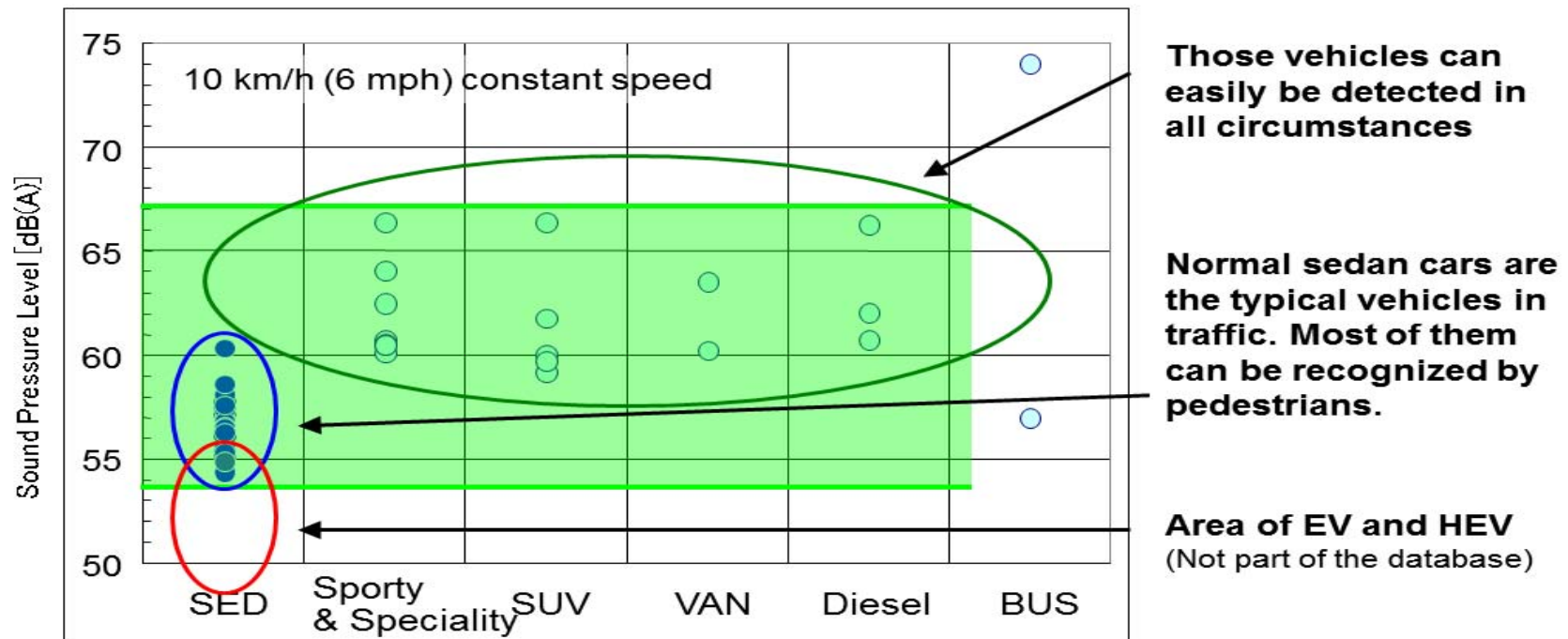
OICA Study 2011

Result of Overall Sound Level at 10km/h (6mph)



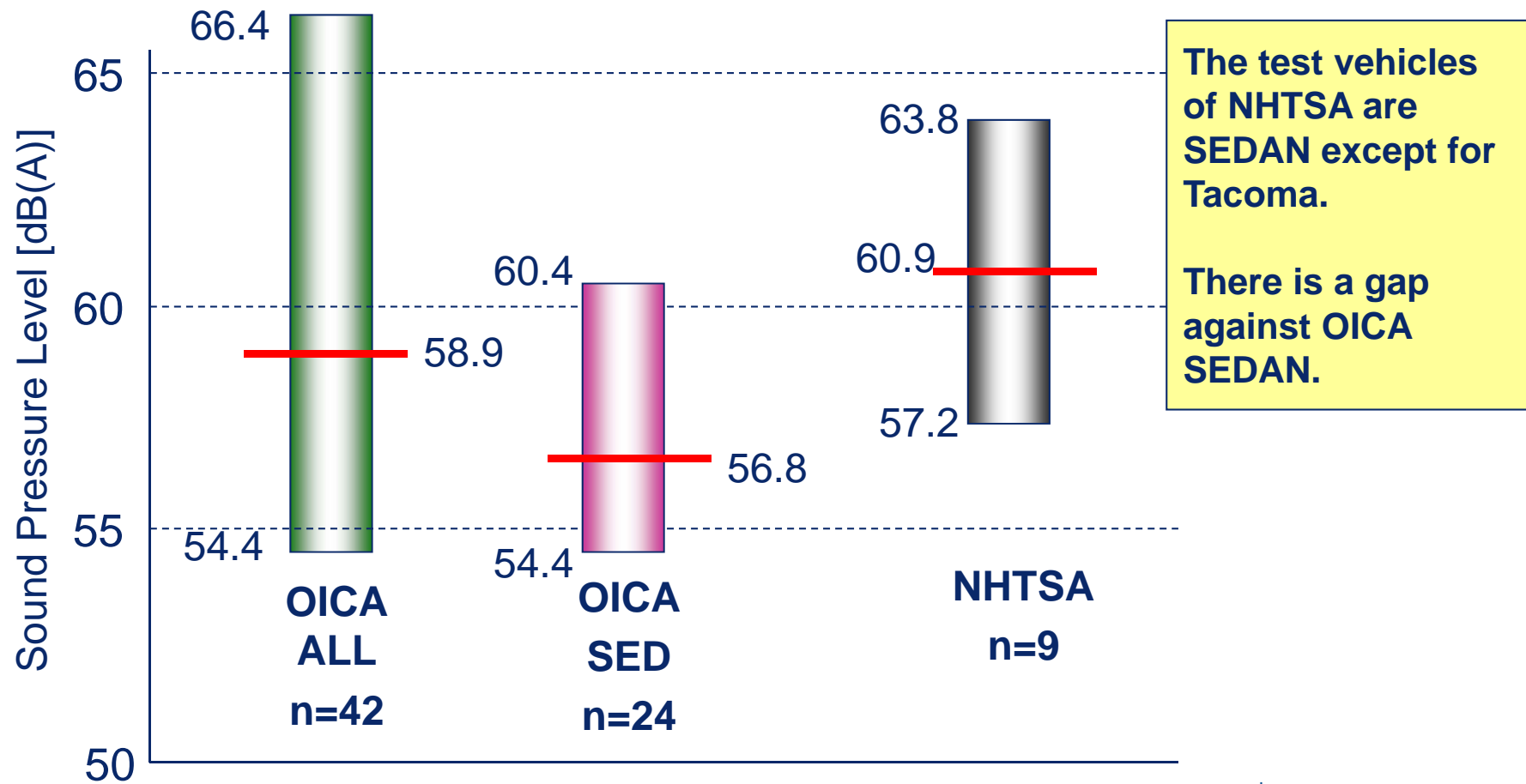
INTERNATIONAL ORGANIZATION OF MOTOR VEHICLE MANUFACTURERS

OICA Data structured for different vehicle classes



OICA Study 2011

Incorporation of NHTSA Data - Result of Sound level at 10km/h (6mph)



Observations

- Manufacturer do overshoot in those bands where specifications are given, to guarantee compliance in all eventual testing situations.
- Some vehicle bring in already reasonable “natural sound” which can vary in day-to-day or even site-to site variation.
- The vehicles will become louder as theoretically drafted.
- Due to the circumstance that the USA specifies 8 essential bands, the overall level for a vehicle with is designed to surely pass all those specifications, the vehicle will become louder than today’s vehicles.
- Japan and VDA specify only two bands and in addition lower sound levels and still provide an acceptable detectability.

Suggestion

- The frequency range from 160Hz to 5000Hz is a good range. Any frequency is suitable for detectability.
- One can discuss to blank some bands around 1000Hz, but there is no real need for it. If the sound levels are selected with care, there is no risk to jeopardize traffic noise reduction aims.
- Two bands are sufficient as requirement, the vehicle will add “natural additional sound” in many cases.
- An overall sound level per test condition should be specified as well.

- It is suggested to invite all parties that have generated data, to merge their data together.
- The whole database should be re-analyzed to determine, re-assess or validate the given proposals for sound levels again.