

OICA Status Report: Quiet Car

December 5, 2012

Berlin, Germany

Data Collection Plan

- ISO/SAE developed data collection plan to address published VOLPE/NHTSA research report.
 - Work Package 1: Measurement of vehicles at the conditions outlined by NHTSA/Volpe in the published research report. Measurements include both Indoor and Outdoor evaluations.
 - Data collected to date: Background noise evaluations, vehicle measurements
 - Work package 2: Measurement of interior sound (recordings and analysis), Evaluation of transmission loss.
 - Data collected to date: Recordings available, Transmission Loss evaluated.
 - Work Package 3: Correlation of detection and recognition to proposed levels.
 - Data collected to date: Jury evaluations of detection and recognition
 - Work Package 4: Measurement of Frequency shift at conditions outlined in NHTSA/Volpe research report
 - Data collected to date: Indoor and outdoor evaluations

Vehicle Noise Measurements

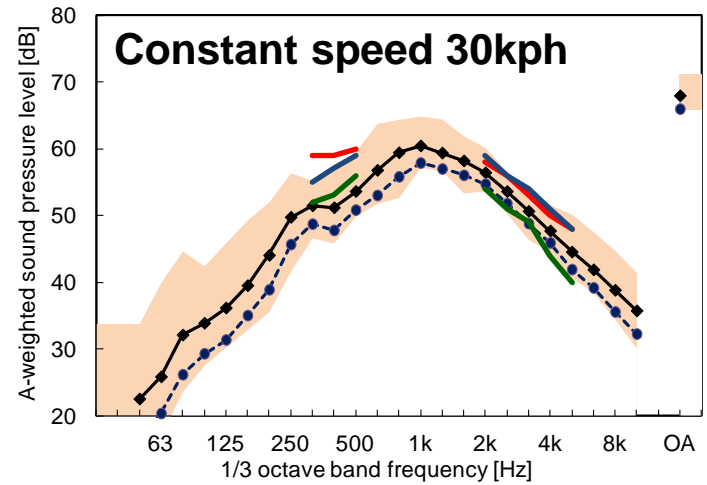
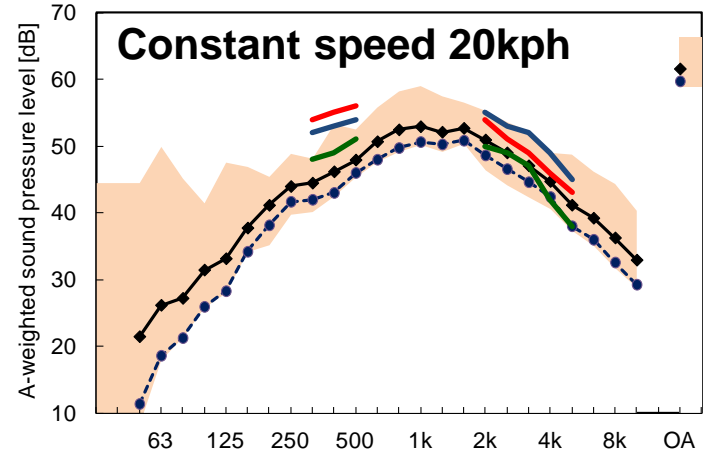
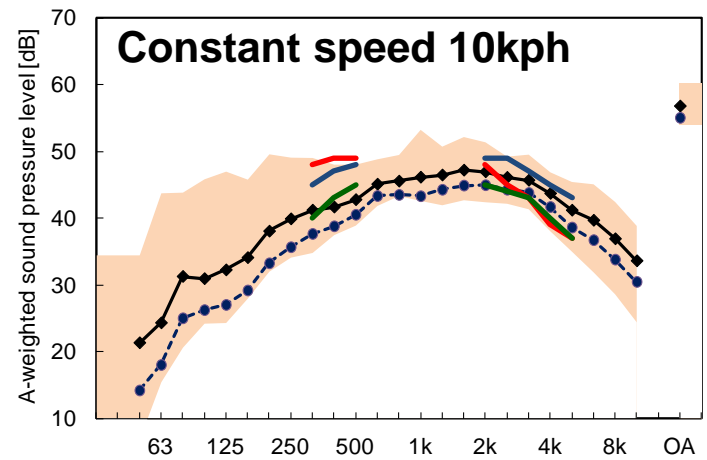
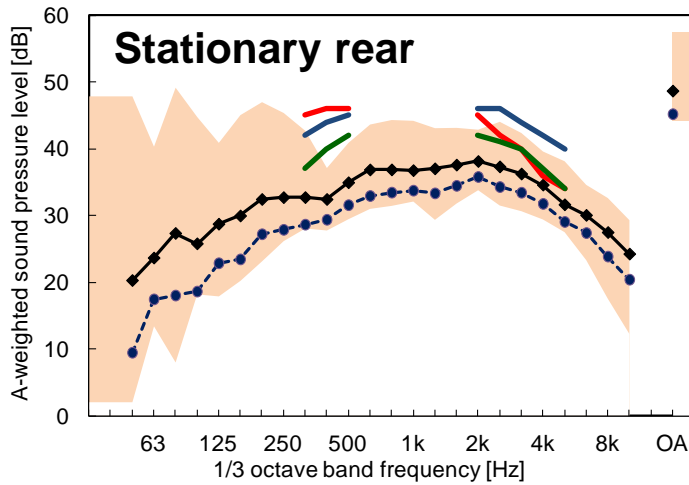
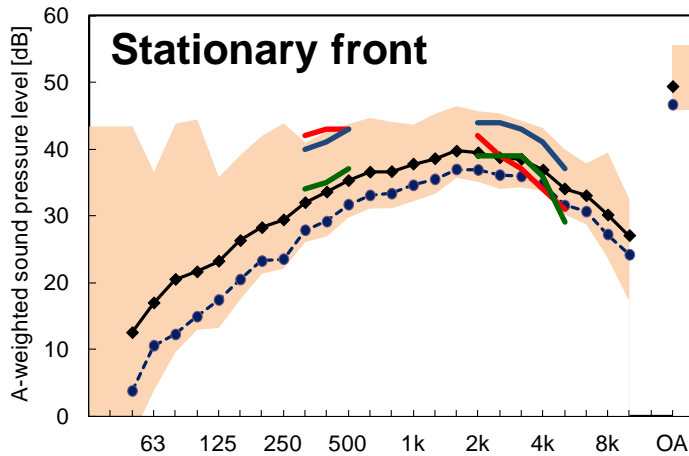
- Database Details
- Visual summary of database
- Individual vehicles

Database Details

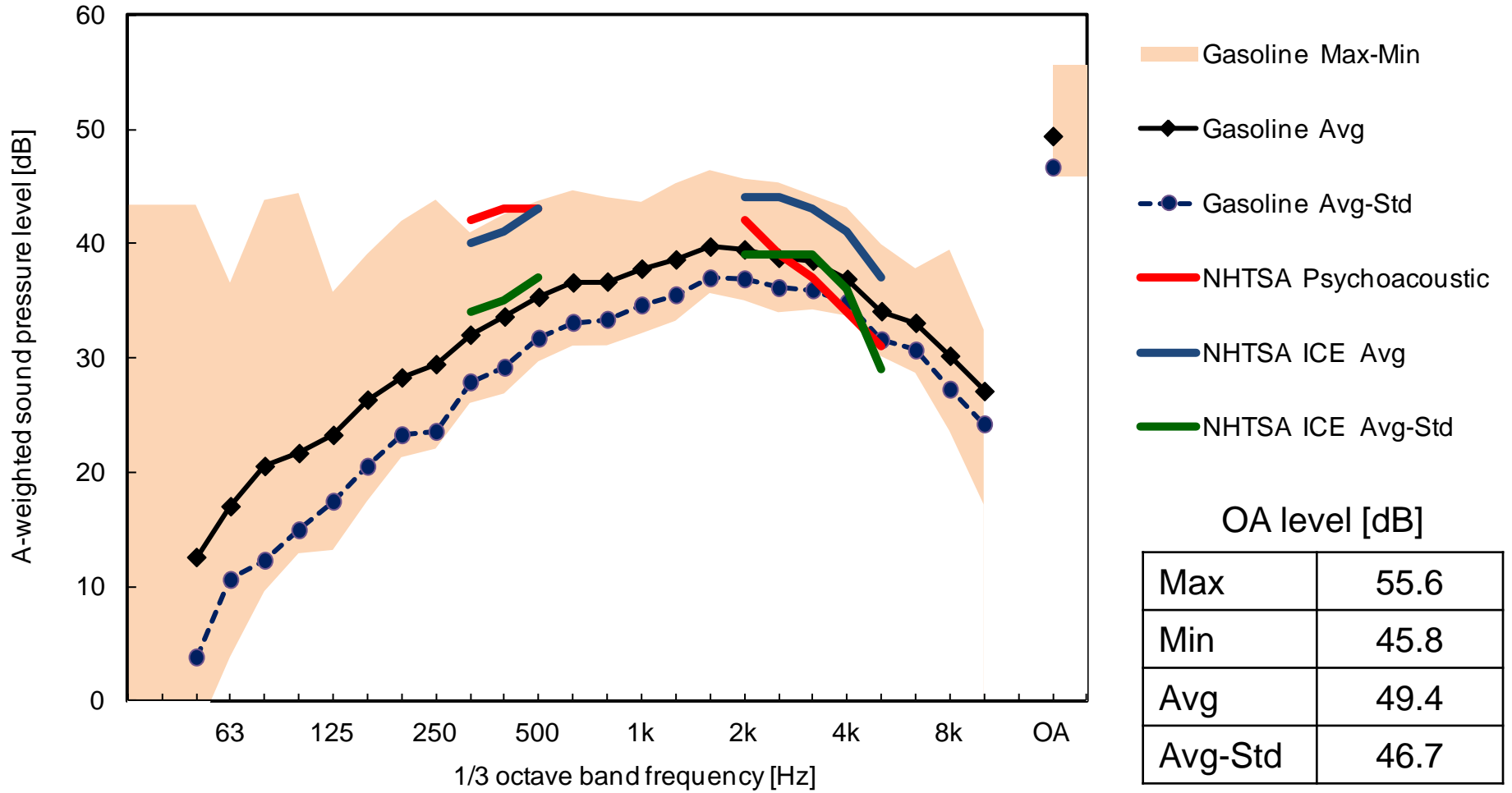
- OICA Database 2012 for QRTV contains about 97 vehicle, further data to be expected
- Measurements:
 - Cruise-by data at 2m microphone distance
 - Stationary data at 5 microphone positions
 - Reverse Sound (Gear Selector put in R, but vehicle at stationary)
 - Background noise
 - Type Approval Data according ECE R51 Method B (Lwot, Lcrs, Lurban)
 - Overall Level and 3rd Octave band analysis
- Ongoing Data collection:
 - Interior noise measurements
 - Vehicle approach measurements for detection assessment by juries.

ICE data

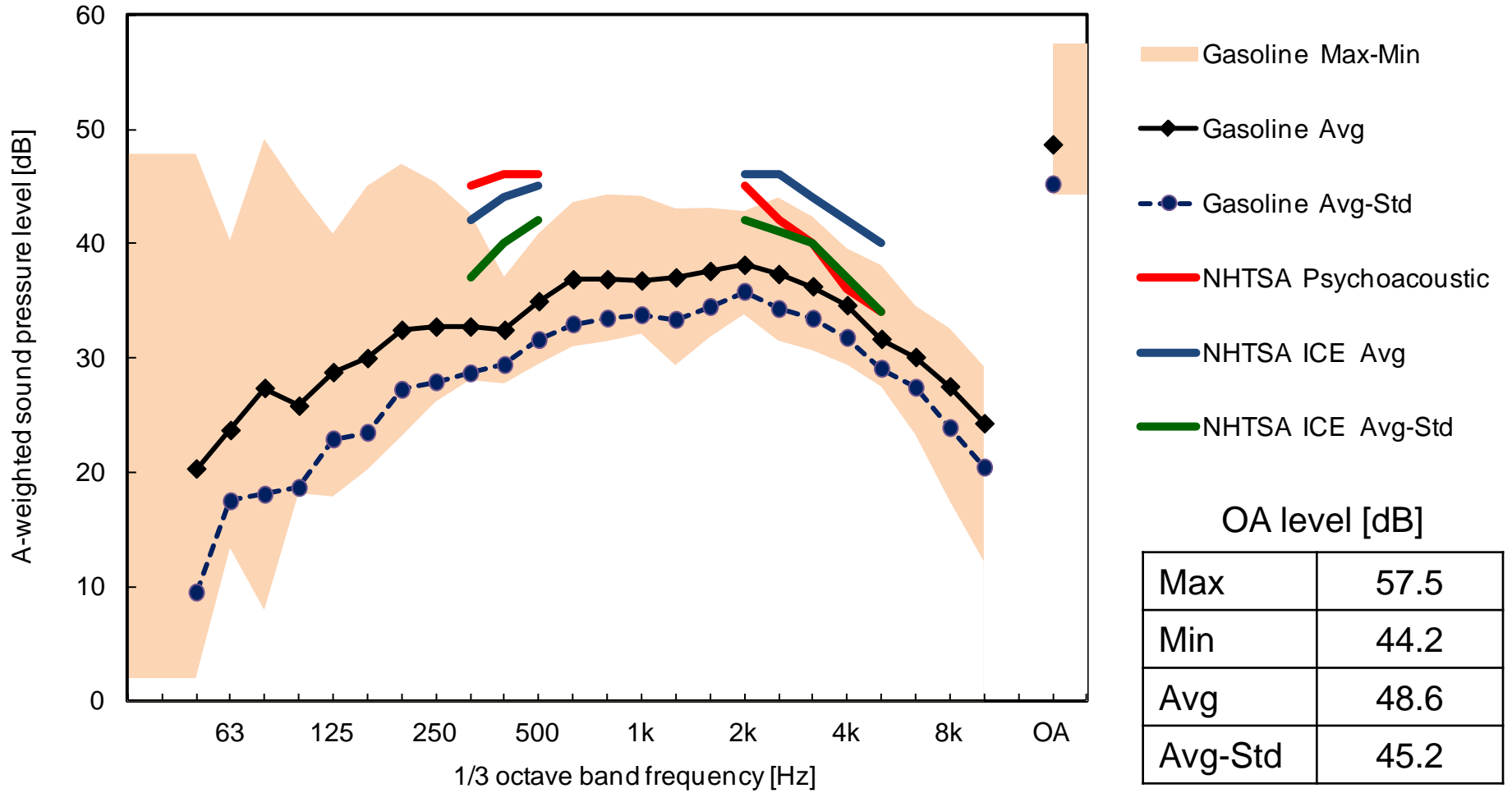
- Gasoline Max-Min
- Gasoline Avg
- Gasoline Avg-Std
- NHTSA Psychoacoustic
- NHTSA ICE Avg
- NHTSA ICE Avg-Std



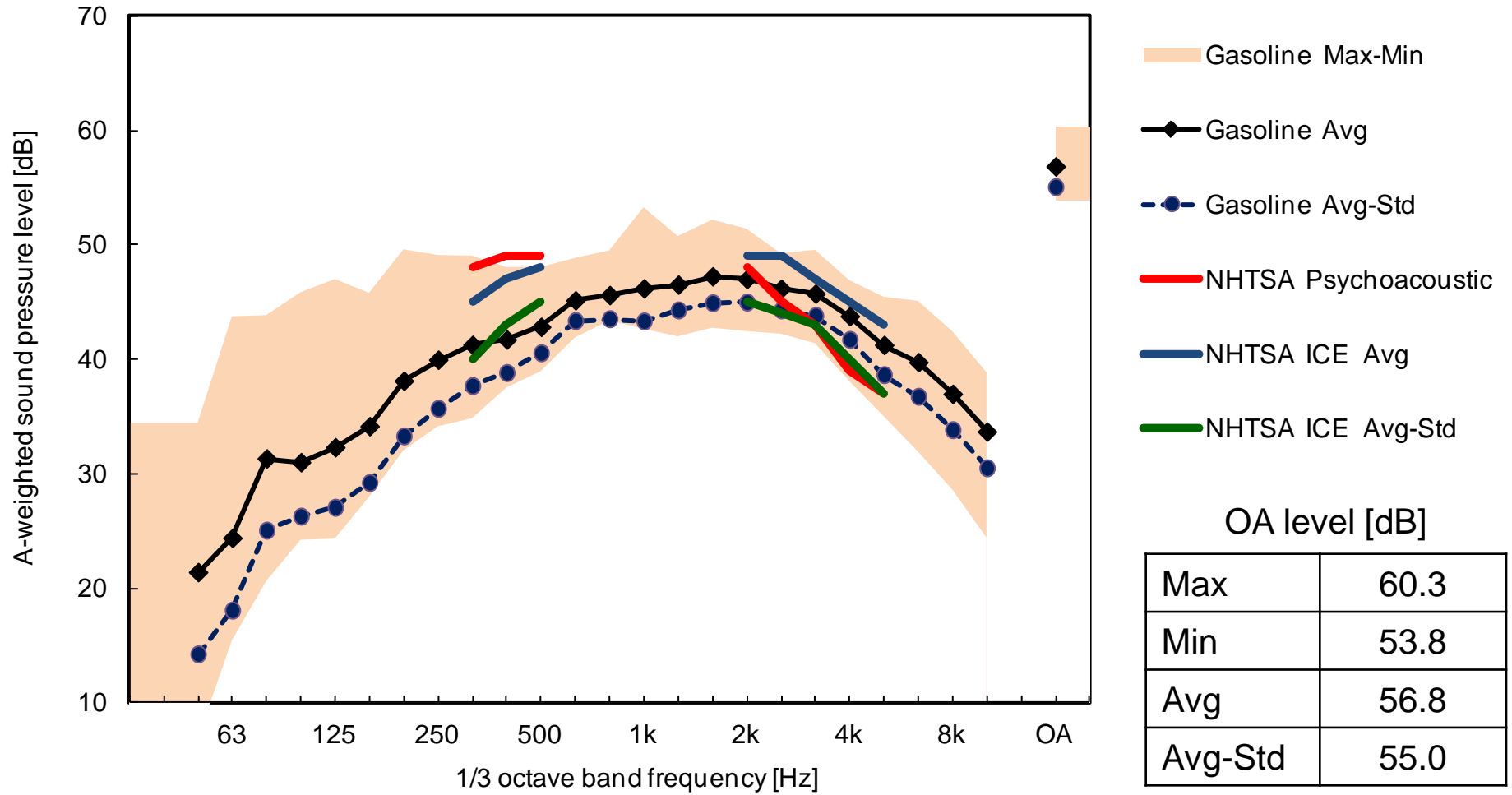
ICE Gasoline: Stationary (Forward, D-range, n=35)



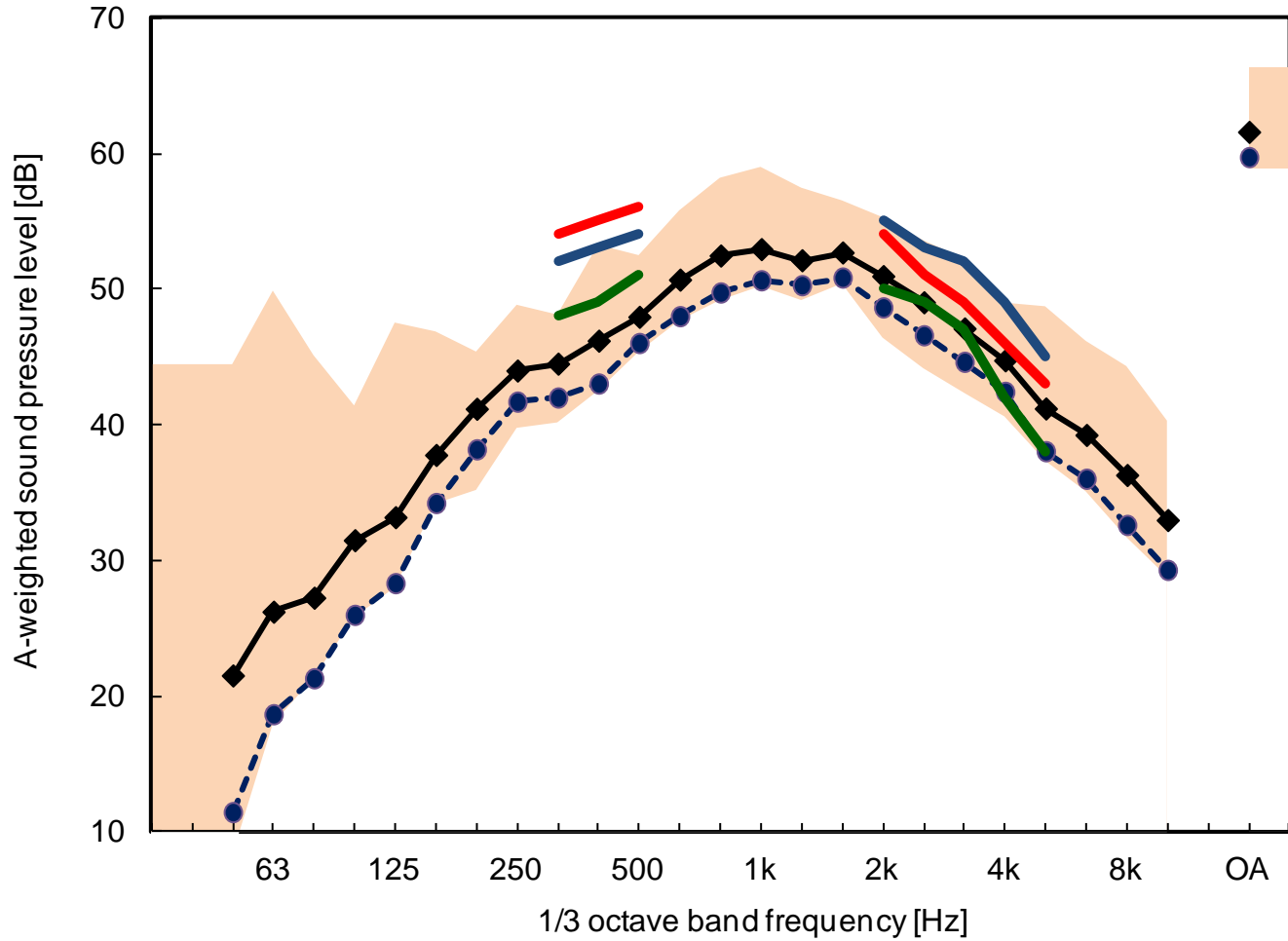
ICE Gasoline : Stationary (Reverse, R-range, n=17)



ICE Gasoline : 10 km/h (n=24)



ICE Gasoline : 20 km/h (n=14)

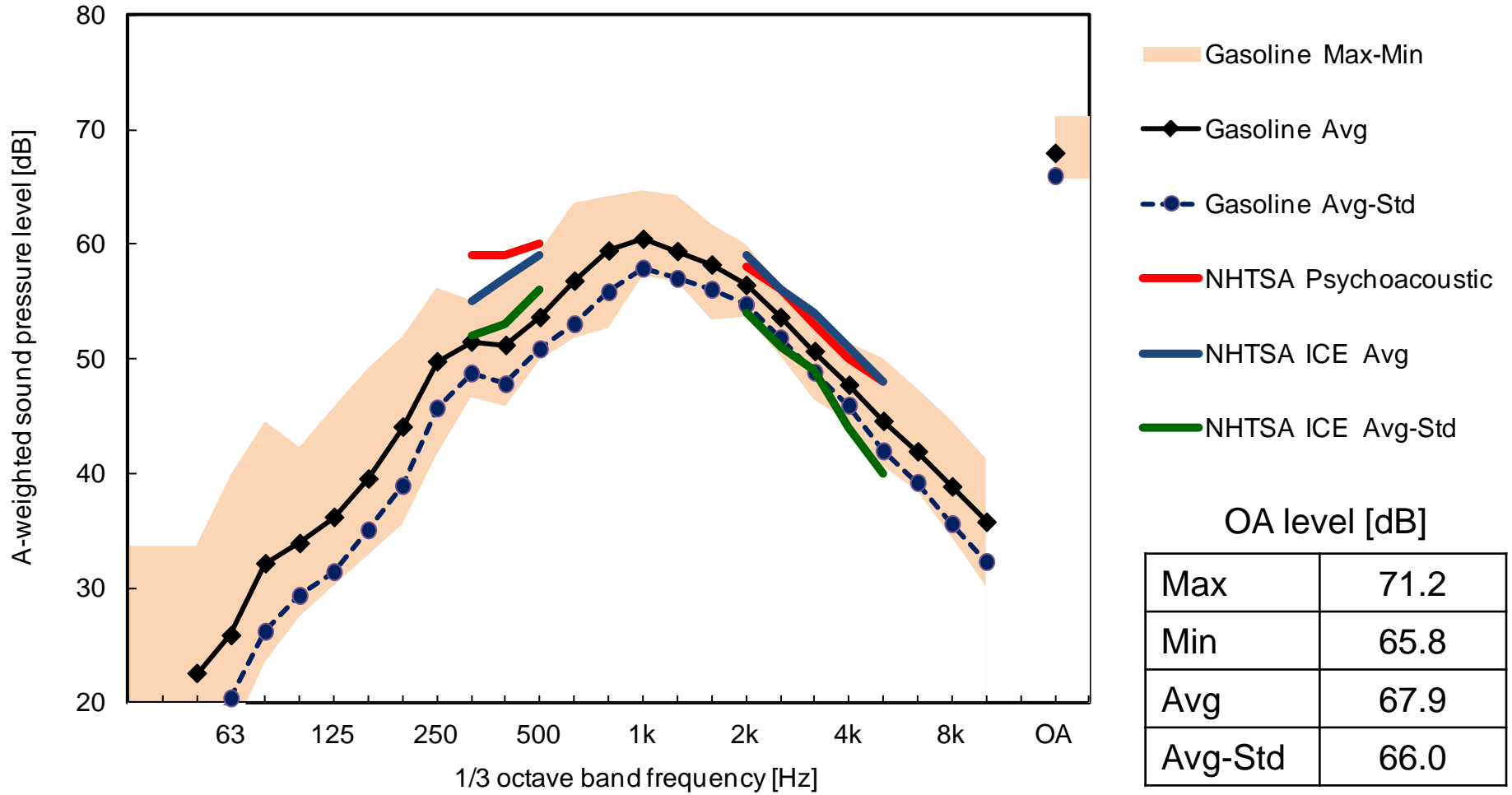


- Gasoline Max-Min
- Gasoline Avg
- Gasoline Avg-Std
- NHTSA Psychoacoustic
- NHTSA ICE Avg
- NHTSA ICE Avg-Std

OA level [dB]

Max	66.4
Min	58.9
Avg	61.6
Avg-Std	59.7

ICE Gasoline : 30 km/h (n=14)



RESULTS OF MEASUREMENT PROGRAM VS NHTSA - REQUIREMENTS

vehicles of no concern – sport car, diesel car

third octave	NHTSA forward	av_10s forward	NHTSA backing	av_10s backing	NHTSA 10kph	max 10kph	NHTSA 20kph	max 20kph	NHTSA 30kph	max 30kph
315	42	42,4	45	42,7	48	45,5	54	49,4	59	53,2
400	43	46,2	46	43,0	49	48,9	55	51,4	59	54,6
500	43	47,7	45	45,0	49	50,2	56	51,4	60	55,3
2000	45	48,5	45	45,1	48	54,9	54	52,3	58	57,5
vehicle1	47,9	42	45,1	45,1	51	50,2	56	56,2	56	56,2
3150	37	44,5	40	41,5	49	46,8	49	47,0	53	51,9
4000	34	39,8	36	37,7	39	45,2	43,8	50	47,4	47,4
5000	31	38,3	34	36,1	37	43,1	41,3	48	44,5	44,5
OAL	49	58,7	52	59,3	55	61,3	62	62,9	66	68,1

match quality: 50%

quiet vehicles – comfort-, hybrid car

third octave	NHTSA forward	av_10s forward	NHTSA backing	av_10s backing	NHTSA 10kph	max 10kph	NHTSA 20kph	max 20kph	NHTSA 30kph	max 30kph
315	42	39,0	45	40,8	48	41,5	54	45,9	59	49,8
400	43	39,2	46	40,3	49	43,0	55	48,4	59	50,4
500	43	39,4	45	40,5	49	42,7	56	51,0	60	53,6
2000	45	44,4	45	44,4	48	47,8	54	57,1	58	58,1
vehicle4	41,0	42	45,7	45,3	51	52,8	56	53,6	56	53,6
3150	37	38,5	40	34,0	49	39,9	49	50,0	53	50,0
4000	34	37,8	36	32,5	39	38,0	46,1	50	46,4	46,4
5000	31	35,4	34	31,0	37	36,4	44,2	48	43,8	43,8
OAL	49	51,6	52	50,6	55	55,5	62	64,5	66	67,4

match quality: 30%

third octave	NHTSA forward	av_10s forward	NHTSA backing	av_10s backing	NHTSA 10kph	max 10kph	NHTSA 20kph	max 20kph	NHTSA 30kph	max 30kph
315	42	40,6	45	40,2	48	48,1	54	47,6	59	52,0
400	43	43,2	46	40,5	49	46,2	55	53,7	59	55,0
500	43	43,8	45	44,8	49	49,6	56	55,3	60	56,0
2000	45	47,9	45	48,1	48	49,1	54	54,9	58	56,9
vehicle2	44,8	42	44,5	49,8	51	53,2	56	54,5	56	54,5
3150	37	43,8	40	43,7	49	45,2	49	52,2	53	50,6
4000	34	43,2	36	42,9	39	47,7	46,9	50	49,7	49,7
5000	31	39,9	34	37,8	37	42,6	45,8	48	46,0	46,0
OAL	49	56,5	52	54,9	55	60,0	62	65,8	66	67,2

match quality: 60%

third octave	NHTSA forward	av_10s forward	NHTSA backing	av_10s backing	NHTSA 10kph	max 10kph	NHTSA 20kph	max 20kph	NHTSA 30kph	max 30kph
315	42	41,4	45	43,5	48	40,2	54	45,0	59	50,3
400	43	44,7	46	41,1	49	46,0	55	46,0	59	51,3
500	43	45,0	45	42,2	49	44,4	56	48,8	60	50,9
2000	45	42,9	45	44,2	48	44,2	54	48,6	58	53,4
vehicle5	41,1	42	38,7	44,8	51	49,0	56	52,4	56	52,4
3150	37	40,4	40	38,0	49	39,5	49	47,5	53	50,0
4000	34	37,8	36	39,9	39	39,9	45,2	50	46,8	46,8
5000	31	34,5	34	29,9	37	35,4	41,3	48	43,5	43,5
OAL	49	54,7	52	56,3	55	55,3	62	61,8	66	66,7

match quality: 20%

third octave	NHTSA forward	av_10s forward	NHTSA backing	av_10s backing	NHTSA 10kph	max 10kph	NHTSA 20kph	max 20kph	NHTSA 30kph	max 30kph
315	42	45,8	45	37,1	48	44,1	54	47,1	59	57,0
400	43	44,1	46	39,5	49	42,5	55	50,1	59	50,9
500	43	43,1	45	41,6	49	44,8	56	48,0	60	52,2
2000	45	47,4	45	45,1	48	49,9	54	53,8	58	57,4
vehicle3	45,2	42	43,4	48,8	51	50,4	56	54,9	56	54,9
3150	37	41,5	40	40,9	49	45,0	49	47,8	53	51,2
4000	34	42,5	36	38,7	39	44,1	47,0	50	50,0	50,0
5000	31	37,2	34	34,0	37	39,5	42,1	48	44,4	44,4
OAL	49	57,0	52	52,7	55	58,4	62	63,1	66	67,4

match quality: 45%

third octave	NHTSA forward	av_10s forward	NHTSA backing	av_10s backing	NHTSA 10kph	max 10kph	NHTSA 20kph	max 20kph	NHTSA 30kph	max 30kph
315	42	41,1	45	41,1	48	46,8	54	50,9	59	54,6
400	43	33,1	46	34,9	49	42,4	55	46,0	59	57,8
500	43	35,1	45	30,3	49	39,9	56	45,3	60	52,4
2000	45	28,7	45	41,9	48	41,9	54	46,1	58	52,2
vehicle6	25,1	42	21,9	42,3	51	45,6	56	50,6	56	50,6
3150	37	21,1	40	19,0	49	42,5	53	46,9	53	46,9
4000	34	20,4	36	19,4	39	38,0	46	40,2	50	43,5
5000	31	19,8	34	13,5	37	33,6	43	37,8	48	41,7
OAL	49	44,6	52	43,1	55	55,7	62	65,0	66	67,2

match quality: 0%

Example of Vehicles in database:

Test Program for QRTV



SL500

(ICE)



GL350D

(ICE)



Smart ED

(Electrical Drive)



C180

(ICE)



C350

(ICE)

Test Conditions:

- exterior noise test track
- Background noise ~ 40 dB(A)
- Test Specifications
VOLPE Tech Report / SAE J2889-1
- Car Setup - Normal Driving

3rd Octave

10 kph constant speed

[dB(A)]
6th order filter method

45Hz – 11.2kHz

20 – 70 dB(A)

SAE J2889-1

constant speed

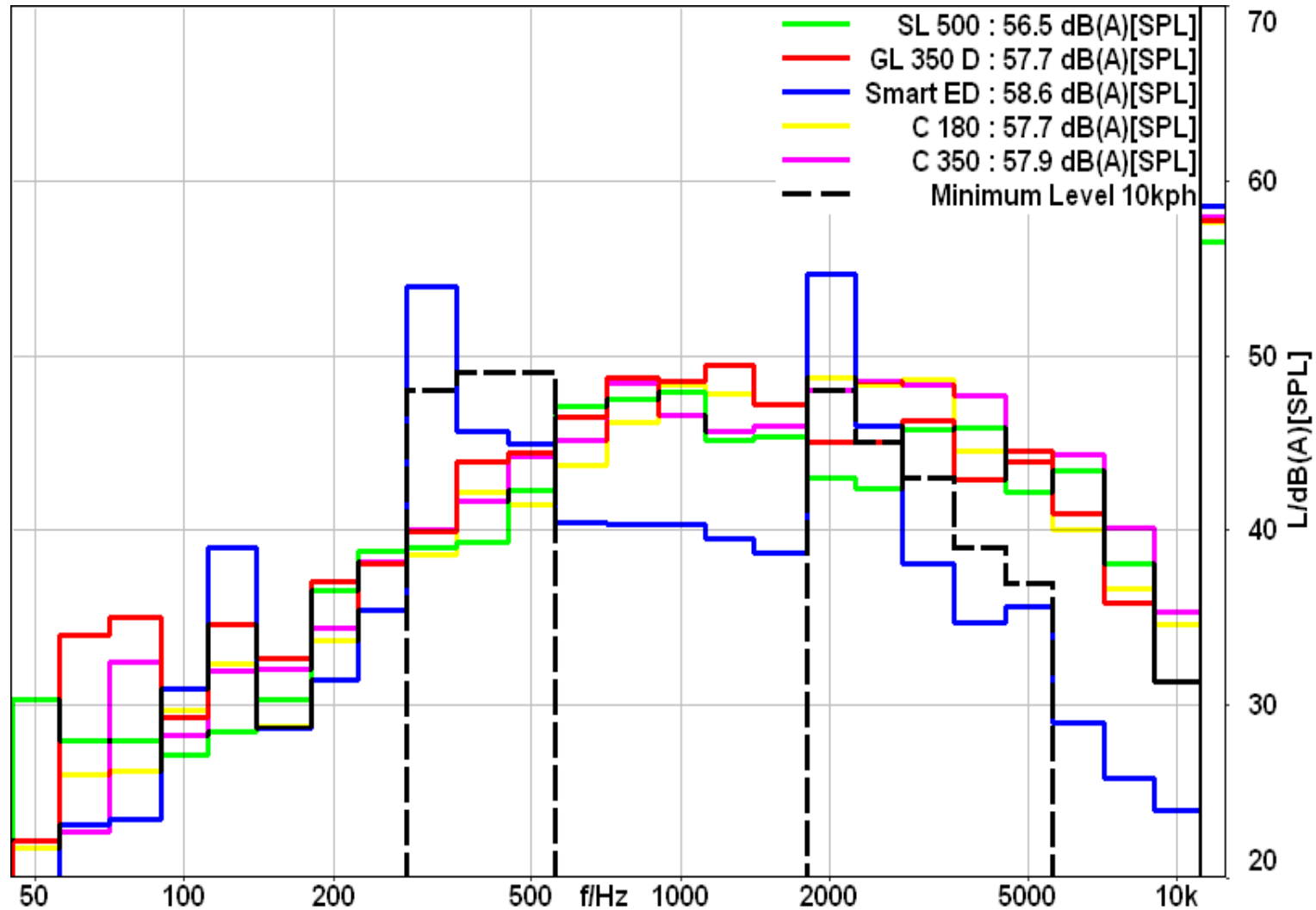
AA' – PP'

Lmax (125ms)

microphones

y= 2m / -2m

z= 1,2m



3rd Octave

20 kph constant speed

[dB(A)]

6th order filter method

45Hz – 11.2kHz

20 – 70 dB(A)

SAE J2889-1

constant speed

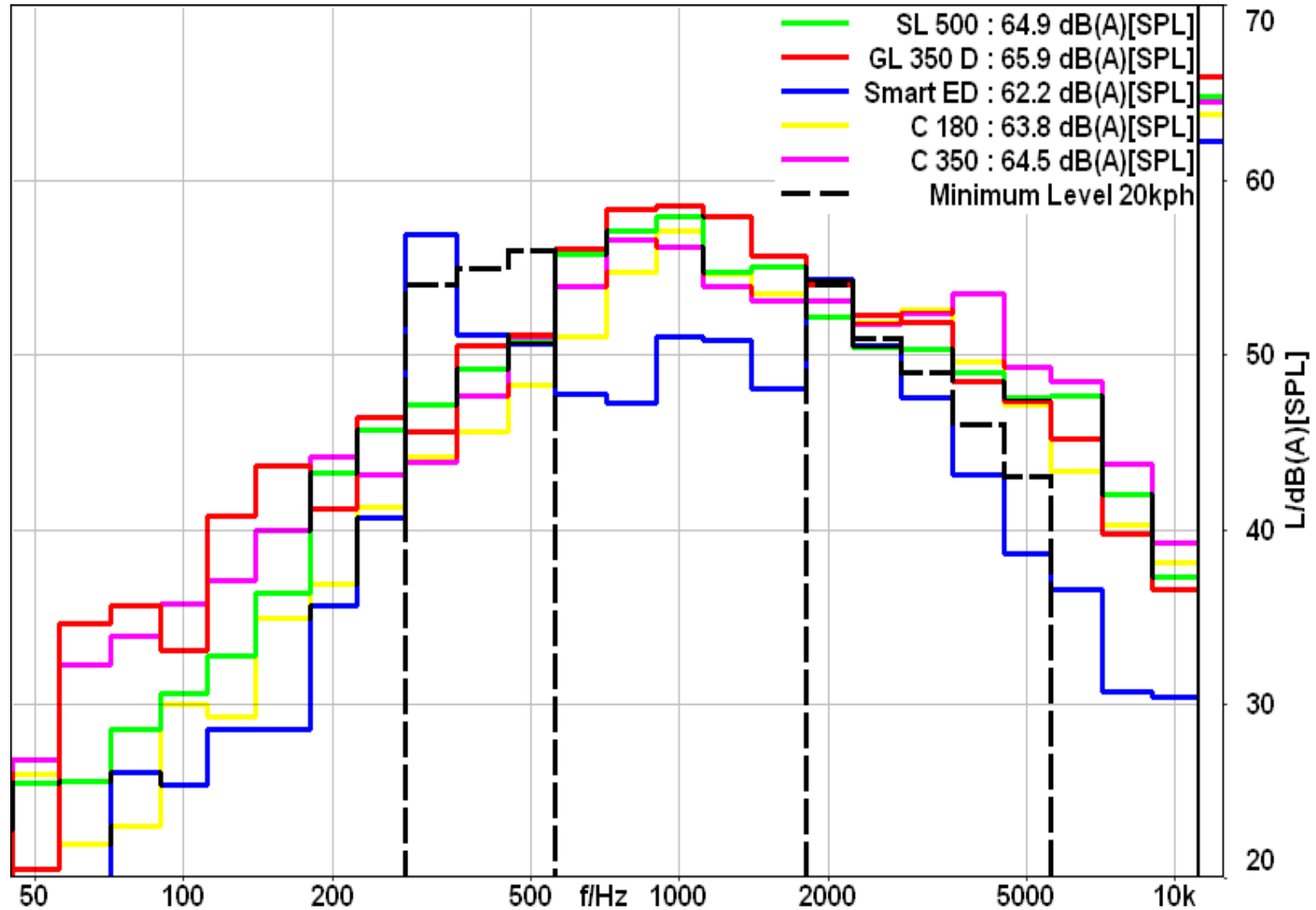
AA' – PP'

Lmax (125ms)

microphones

y= 2m / -2m

z= 1,2m



3rd Octave

30 kph constant speed

[dB(A)]
6th order filter method

45Hz – 11.2kHz

20 – 70 dB(A)

SAE J2889-1

constant speed

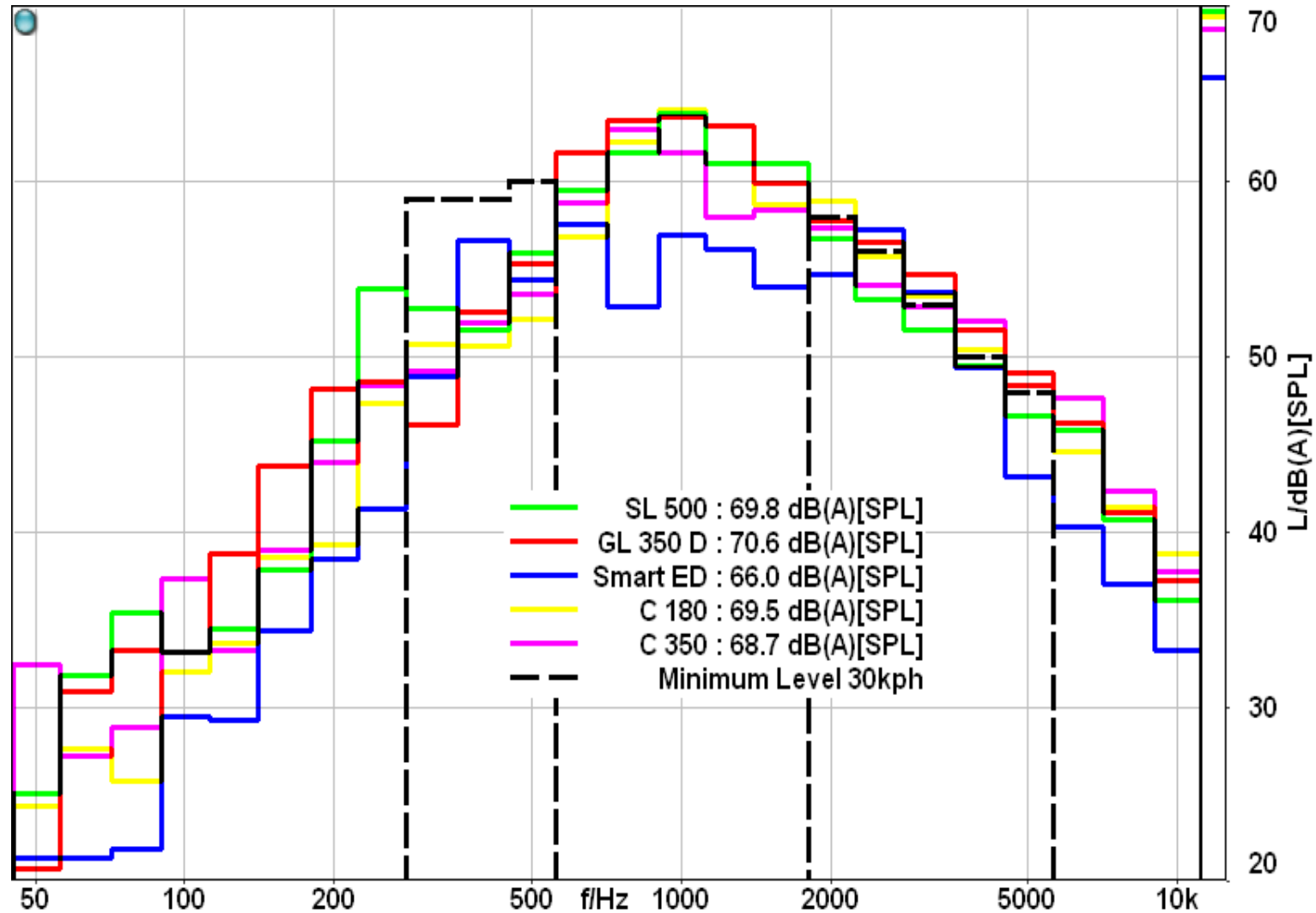
AA' – PP'

Lmax (125ms)

microphones

y= 2m / -2m

z= 1,2m



Example of Vehicles in database:

Test Program for QRTV



Panamera S Hybrid

(ICE-Mode & Sound Mode)



Panamera GTS

(ICE)



911 Carrera (991)

(ICE)



GT3 4.0 (997)

(ICE)

Test Conditions:

- exterior noise test track
- Background noise ~ 40 dB(A)
- Test Specifications
VOLPE Tech Report / SAE J2889-1
- Car Setup - Normal Driving

3rd Octave

10 kph constant speed

[dB(A)]
6th order filter method

45Hz – 11.2kHz

SAE J2889-1

constant speed

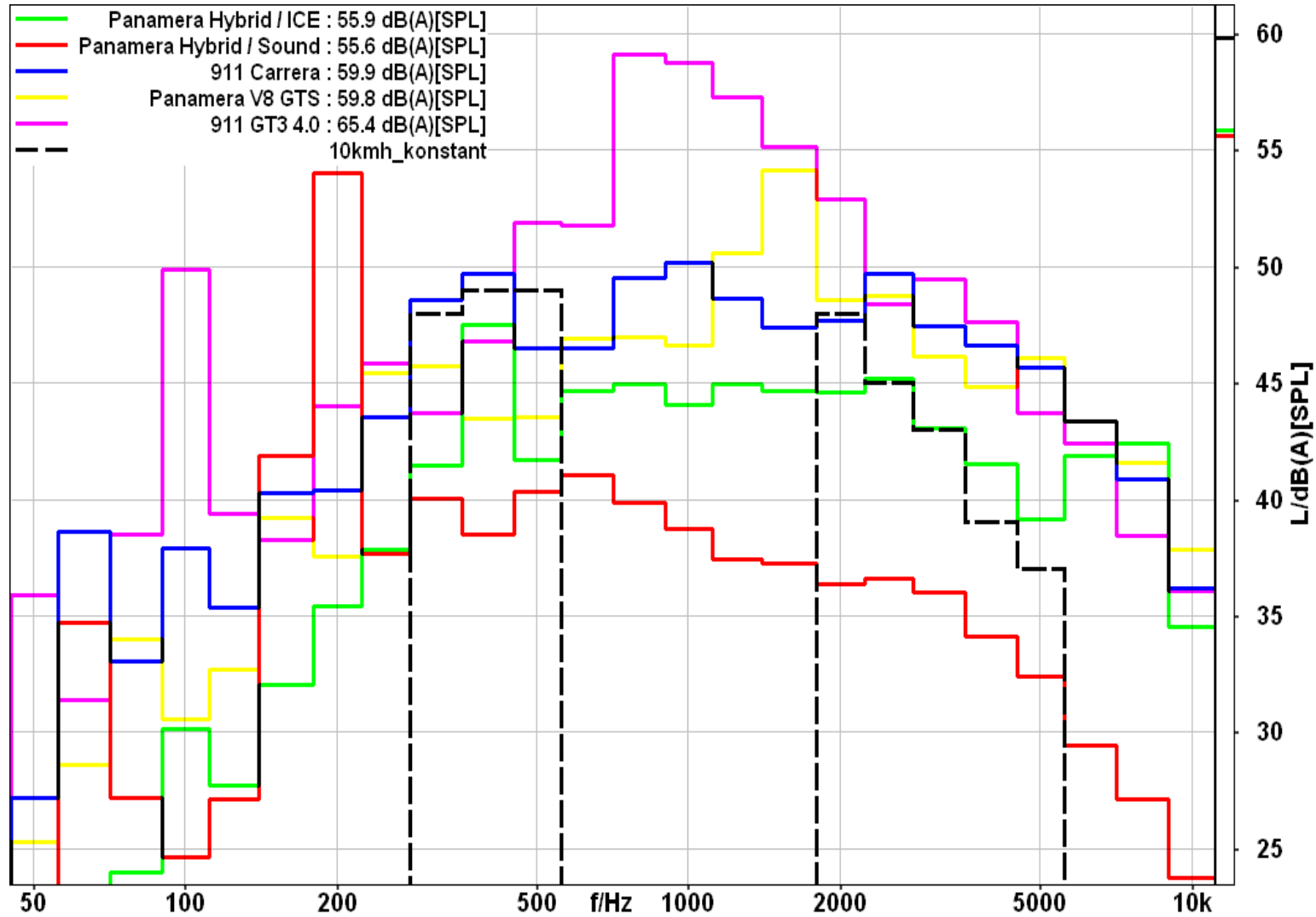
AA' – PP'

125ms to Lmax

microphones

y= 2m / -2m

z= 1,2m



3rd Octave

20 kph constant speed

[dB(A)]
6th order filter method

45Hz – 11.2kHz

SAE J2889-1

constant speed

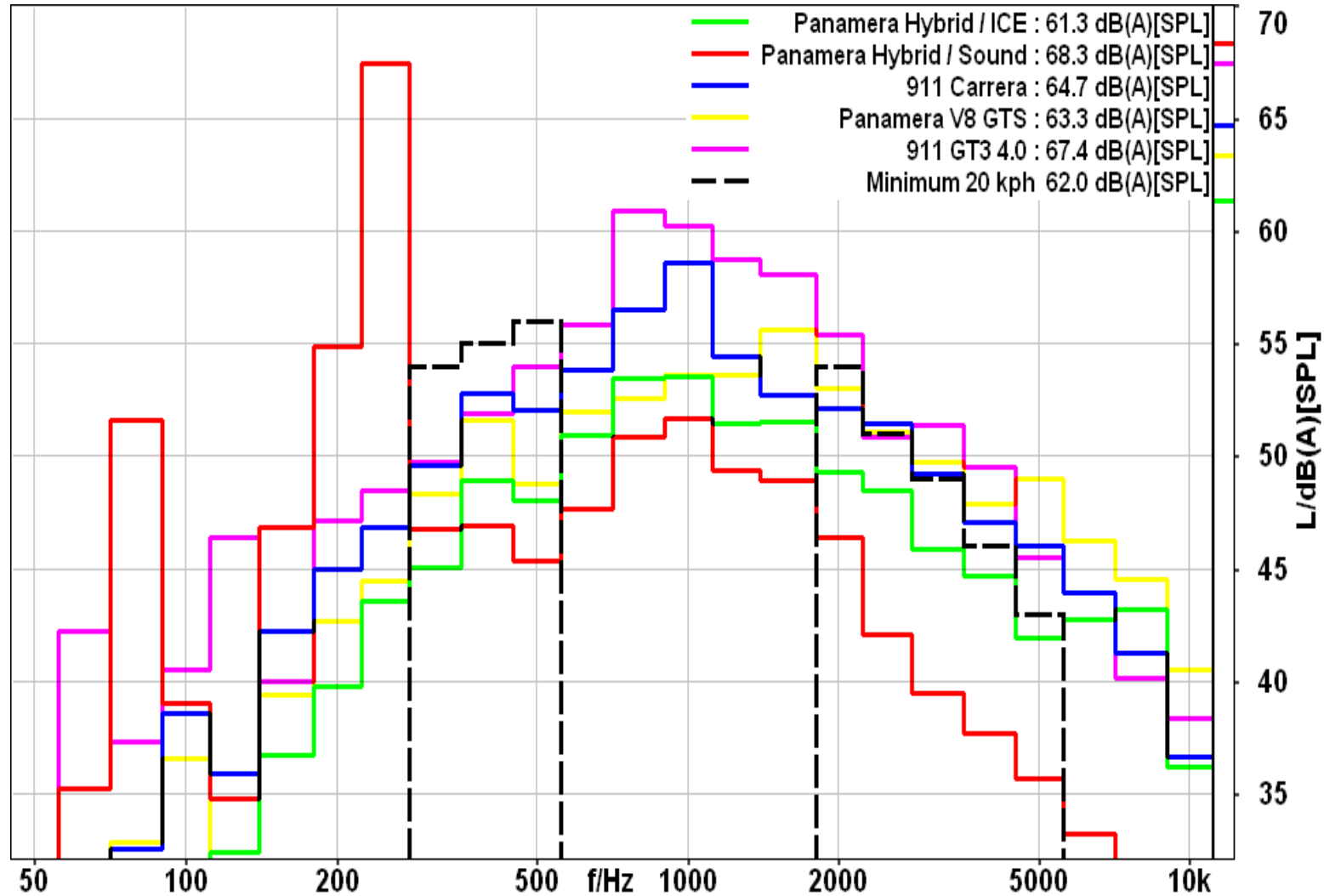
AA' – PP'

125ms to Lmax

microphones

y= 2m / -2m

z= 1,2m



3rd Octave

30 kph constant speed

[dB(A)]

6th order filter method

45Hz – 11.2kHz

SAE J2889-1

constant speed

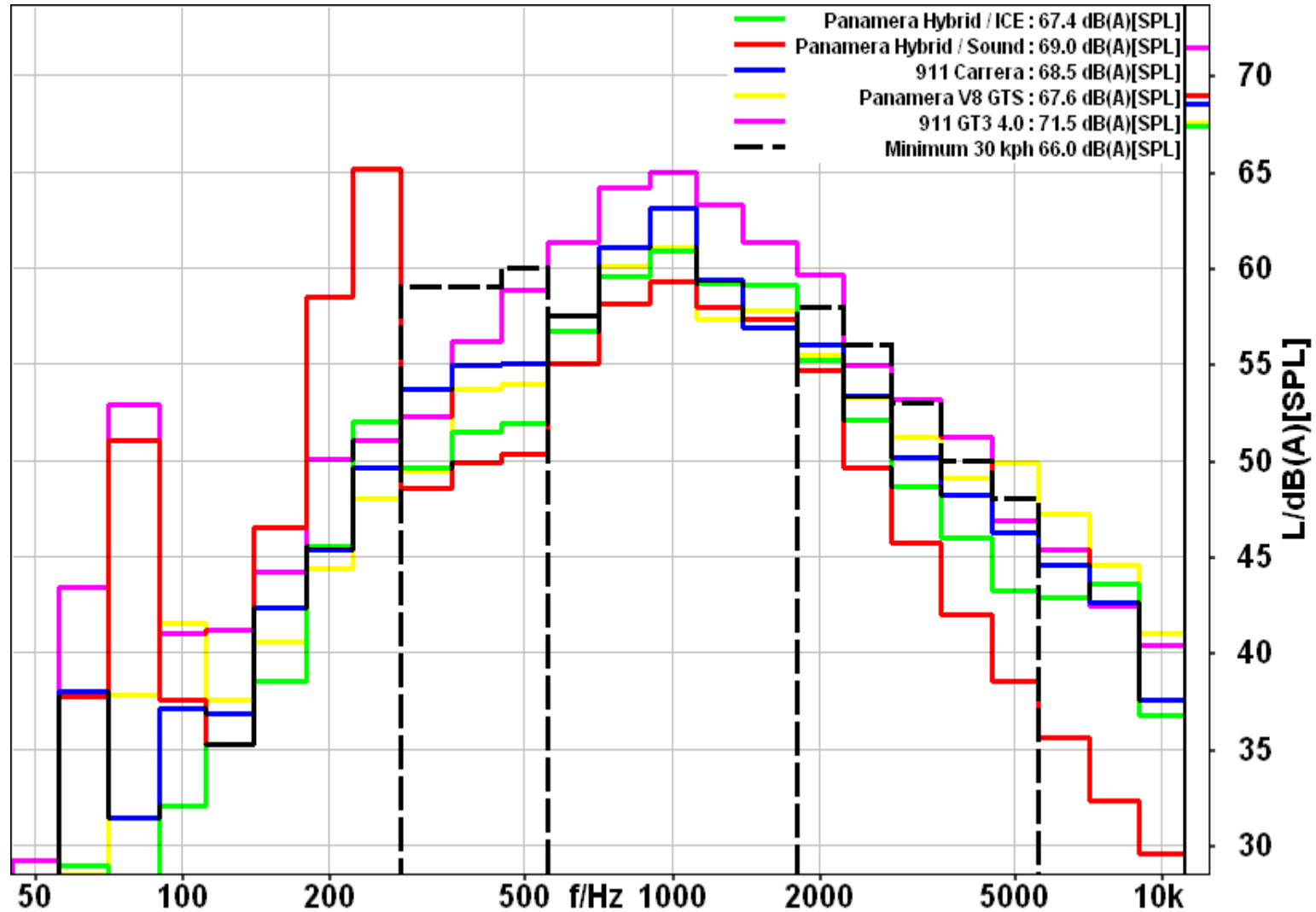
AA' – PP'

125ms to Lmax

microphones

y= 2m / -2m

z= 1,2m



Conclusions

- The Moore Loudness Modell specifies, that a vehicle is detectable if in ONE 3rd octave band the NHTSA specified sound levels are reached.
- In case where eight 3rd octave bands are used, the level need to be adjusted to avoid that vehicles become too loud.
- Or it should be considered that less 3rd octave bands are used, e.g. one or two out of eight.

WORK PACKAGE 2

- Interior Noise Measurements
- Transmission loss

Interior Noise Recordings

- Recordings have been made, but need to know format for circulation to all GTR participants.
 - Recordings contain calibration information so replay levels can be accurately set.
 - Single microphone and binaural recordings

Typical Transmission Loss Function: Engine Compartment to Interior

