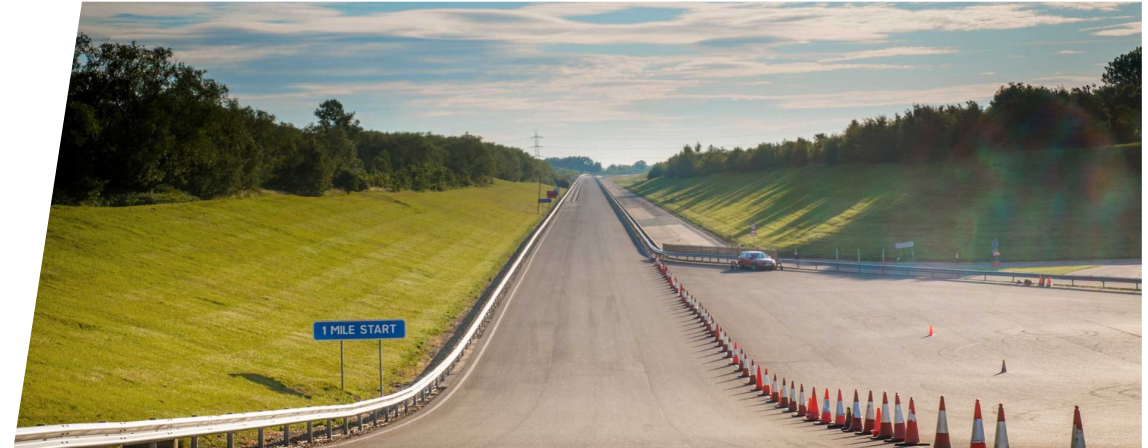




**ACEA study on ASEP**  
*27.05.2024 – WP1*



**ACEA initiated a study on ASEP, which was later joined by several Contracting Parties (France, Germany, Japan, The Netherlands)**

**The study consists of two work packages**



**WP.1: Achievements by ASEP (as in force today)**

**WP.2: Monitoring of RD-ASEP**

**This presentation presents the results of WP.1, started from the following questions:**

- Did ASEP affect product designs?
- Did ASEP lead to a remarkable release of single vehicle annoyance in real traffic?
- How is ASEP handled during type approval?

**The following work packages were carried out**

- **Literature review**, on the development of ASEP and its impact on the product design.
- **Questionnaire survey**, towards manufacturers and contracting parties
- **Test campaign on vehicles**, 8 vehicles (4 twins) tested

## OICA proposal

- Detecting **non-linearities**, cycle-beating, cheating.
- **Engineering** method based on a linear **regression** determined individually per vehicle.
- **Engine speed** based.

## F/D proposal

- Based on **linear sound behaviour**.
- Establishing **limit curves** based on fixed slopes.

## Slope-Assessment

- Combination of F/D and OICA proposals.
- Critics/limitations:
- The engine speed, as only explicative variable, limits the gear ratios to  $k \leq i$  (for limiting the influence of the rolling noise).
- No Not-to-exceed limit (No worst-case).
- Slope-Assessment could allow noisier vehicles than R51.02.

## Model-based approach

## Netherlands proposal

- Establishing **limit curves**.
- Method not based on a physical noise model but geometrically built from both the **anchor** point and a **N-T-E** point at the **maximum** engine speed.
- Dealing with the worst-case, but the slope could be artificially flat, especially for vehicles with high rated engine speed.

## Ref. Sound Assessment

- Preserving the **benefits** of **R51.02**.
- Operating conditions close to 61 km/h and 1.9 m/s<sup>2</sup>.

## L<sub>urban</sub>-Assessment

- Defining a **vehicle of concern** using L<sub>urban</sub> as **metric**.
- **Classifying** method **empirically** established from dataset.
- The assumptions make difficult to understand the physical noise behaviour of the vehicles.

## Not-To-Exceed approach

## Administration's observation: citizens' complaints (from environment groups)

- Sound emitted by M1 cars is perceived as **one source for annoyance**, but less important compared to other sources.

## Administration's action: noise abatement for single events noises

- Installation of automated noise camera to **monitor sound** from passing vehicles
- Such monitoring can be used to gain an overview about **nature, number and timing of any kind of noise events** (sirens, horns, street sweepers, garbage trucks, modified vehicles, reckless driving, buses, trucks and more).

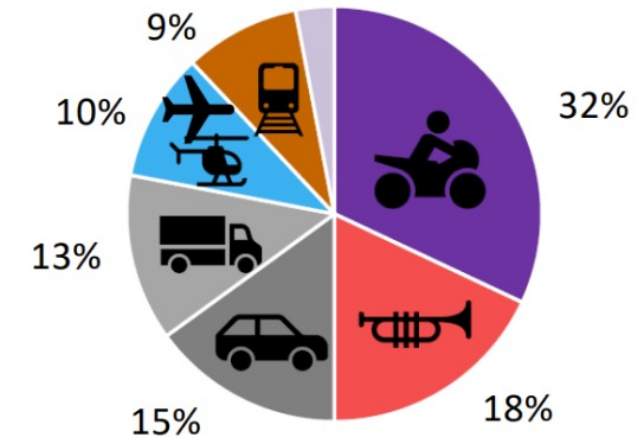
## Manufacturer view: satisfying customers expectation (stipulated by press reports)

- Many customers request a **pleasant sound**.
- Compromise is needed to serve customer and comply with regulations (especially ASEP).

## Press' (motor vehicles magazine) observation:

- The sound of newer car models seem to be **less emotional**.
- Customers report that new cars were "**disappointing** compared to previous models".

Major sources for citizen complaints



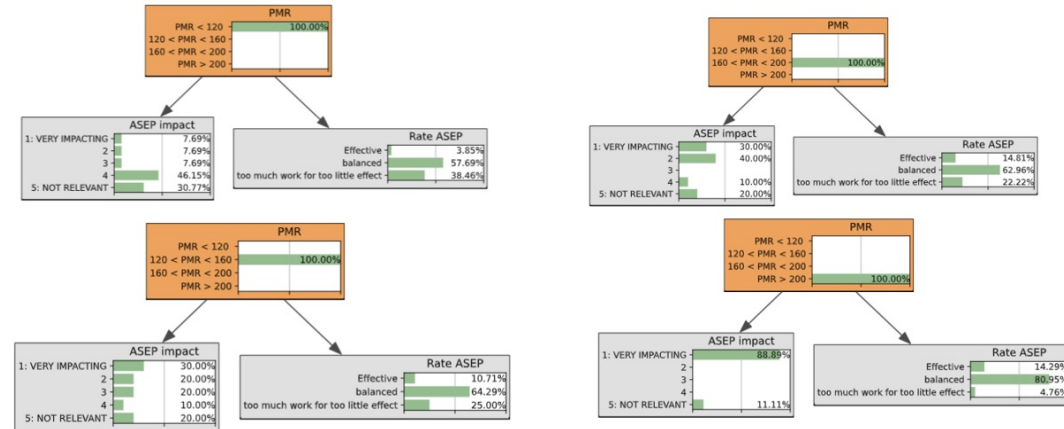
Medusa Noise Monitor



# Key findings from OEMs questionnaire

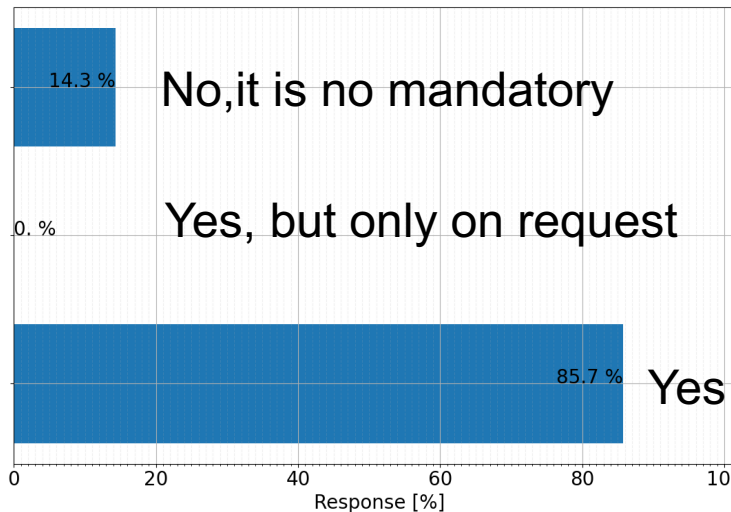
1. Most manufacturers apply the guidance of the GRB-68-03 voluntarily.
2. Correlation between the PMR and the impact of the ASEP.
3. Most manufacturers of vehicles with low PMR are little impacted by ASEP.
4. Most manufacturers of low PMR vehicles consider ASEP too time-consuming with minimal impact.
5. Most manufacturers of high PMR vehicles rate ASEP as being balanced regarding time consumption versus effort on sound reduction.
6. ASEP has an impact, especially on exhaust system, ECU and TCU.

## Way of Data Analysis

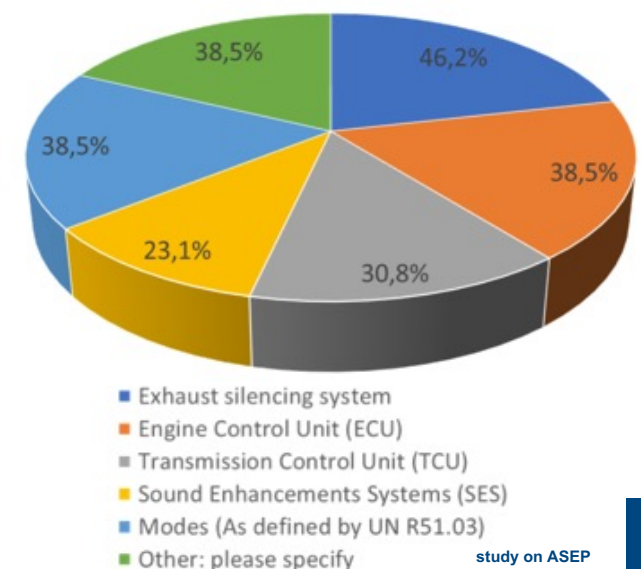


## Answers to the questionnaire:

Do you follow the guidance of GRB-68-03?

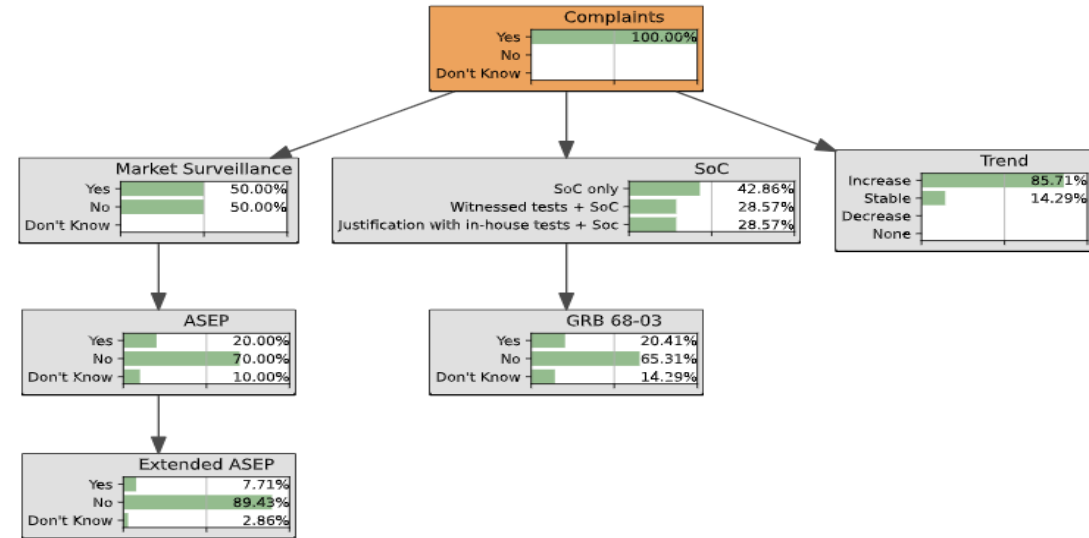


Which components were impacted by ASEP?

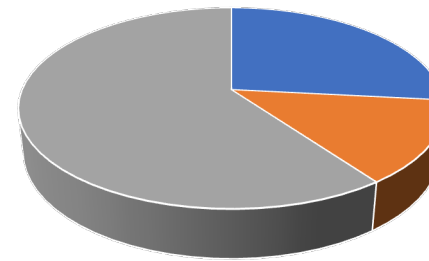


# Key findings from CPs questionnaire

1. The trend of citizens' complaints seem to increase, which could be linked to more awareness of environmental noise issues (after Covid 19, with home office, ...).
2. Vehicle sound is not systematically controlled in the frame of Regulation 2018/858 market surveillance (MaS). Only half of CPs answering to the questionnaire apply MaS for vehicle sound.
3. ASEP is rarely tested during Market Surveillance
4. Low assessment or information regarding the ASEP effectiveness in reducing single vehicle noise.

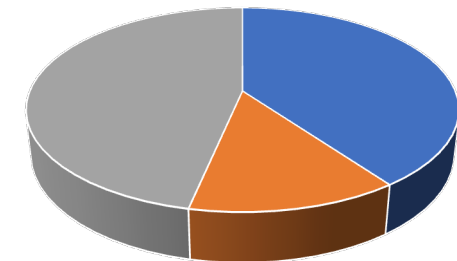


In your opinion, has ASEP contributed to making noisy single vehicles quieter?



■ YES ■ NO ■ DON'T KNOW

Is ASEP an important tool for single vehicle noise abatement ?



■ YES ■ NO ■ DON'T KNOW

## Conclusions:

- At least, the EU system enables multiple tools to enforcement for noise abatement
- A recommendation is to
  - Systematically use the MaS
  - Enforce in-use controls and strength Periodical Technical Inspection (PTI).

## WP1 Test program:

- Tests were performed according to UN R51.02, UN R51.03 and ASEP and partly RD-ASEP based on the test program outlined by the IWG RD-ASEP in 2017/2018.
- Eight vehicles (4 twins) are targeted of which 6 tests (3 twins) have been completed.
  - If possible, twin pairs of vehicles shall be tested,
    - one approved under UN R51.02, and
    - the successor model approved under UN R51.03 (preferably stage 2).
  - Vehicles selection is based on press reports, outcome of questionnaires and availability.
- Availability was a challenge as the target vehicles are high powered and not easy to get.
  - Therefore, data were received from
    - An authority research program of 2018-2020
    - From manufacturer type approval tests (which have been witnessed by their technical service)
- Target to complete all tests by end of July 2024

# TWIN 1 – Technical Background Information

## TWIN 1 – OLD Model

### General Approval Information

Model Year	2015	
<b>Official Approval</b>	<b>UN R51.02</b>	<b>73 dB(A)</b>
For this study	UN R51.03	71 dB(A)

Tech. Data	Value	Unit
Engine	4 cylinder Petrol	1998 cc
Net Power P <sub>n</sub>	201	kW
Rated Engine Speed S	5500	1/min
Curb Mass m <sub>ro</sub>	1545	kg
PMR	143	kW/t
Reference Point	Front	
Tyre Dimension	225/40 ZR18 92W	
Max Vehicle Speed	254	km/h

GEAR RATIOS CALCULATED PER RUN								
AVG	9,6	15,7	21,6	29,1	35,0	43,0		
i	1	2	3	4	5	6	7	8

## TWIN 1 – NEW Model

### General Approval Information

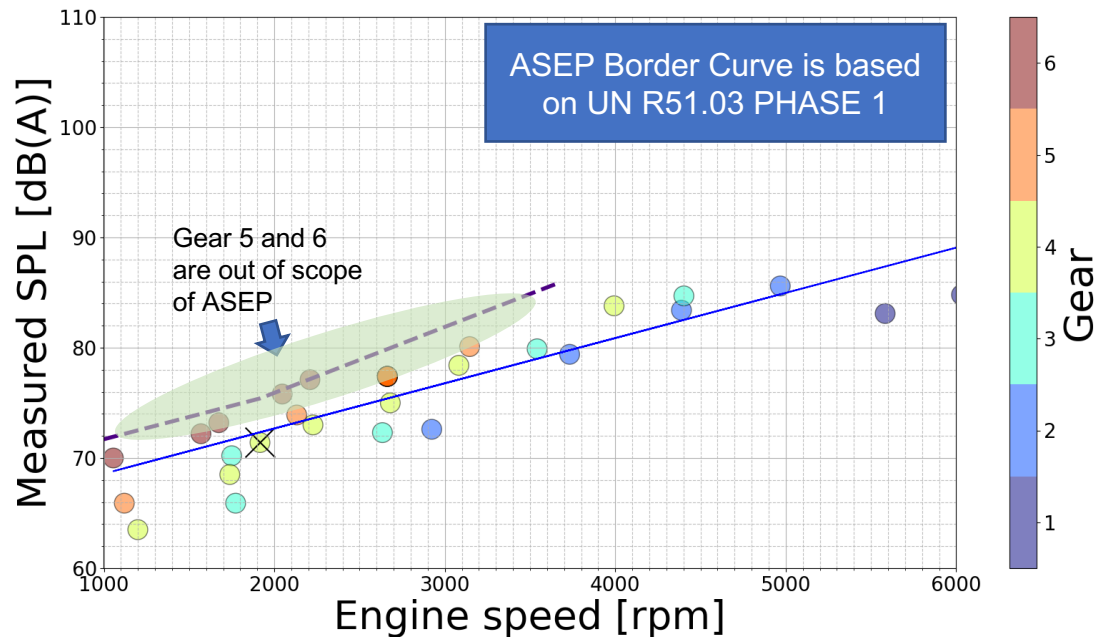
Model Year	2022	
For this study	UN R51.02	73 dB(A)
<b>Official Approval</b>	<b>UN R51.03</b>	<b>70 dB(A)</b>

Tech. Data	Value	Unit
Engine	4 cylinder Petrol	1,798 cc
Net Power P <sub>n</sub>	221	kW
Rated Engine Speed S	8250	1/min
Curb Mass m <sub>ro</sub>	1569	kg
PMR	141	kW/t
Reference Point	Front	
Tyre Dimension	235/40 ZR18 91Y	
Max Vehicle Speed	255	km/h

GEAR RATIOS CALCULATED PER RUN								
AVG	8,7	14,0	20,1	27,5	34,8	42,4		
i	1	2	3	4	5	6	7	8

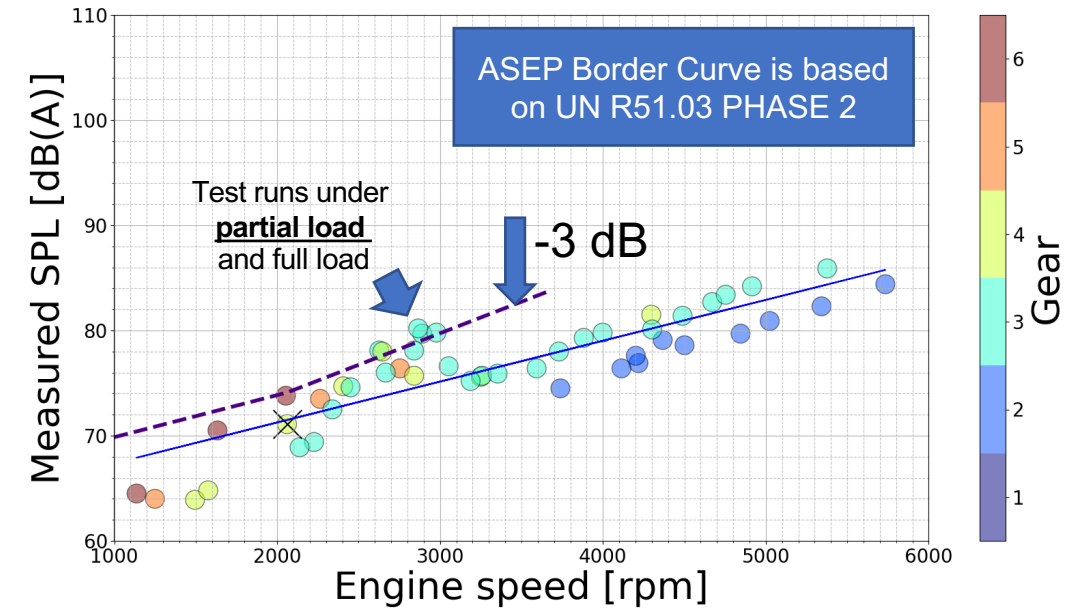


## TWIN 1 – OLD Model



Data Source: UTAC test data, 2024

## TWIN 1 – NEW Model



Data Source: UTAC test data, 2024

### FINDINGS:

- ❖ Old model is not affected by ASEP
- ❖ New model struggles more with the ASEP border curve created by a tailpipe resonance.
- ❖ However, especially for high engine revolutions show much lower sound levels compared to the old model.

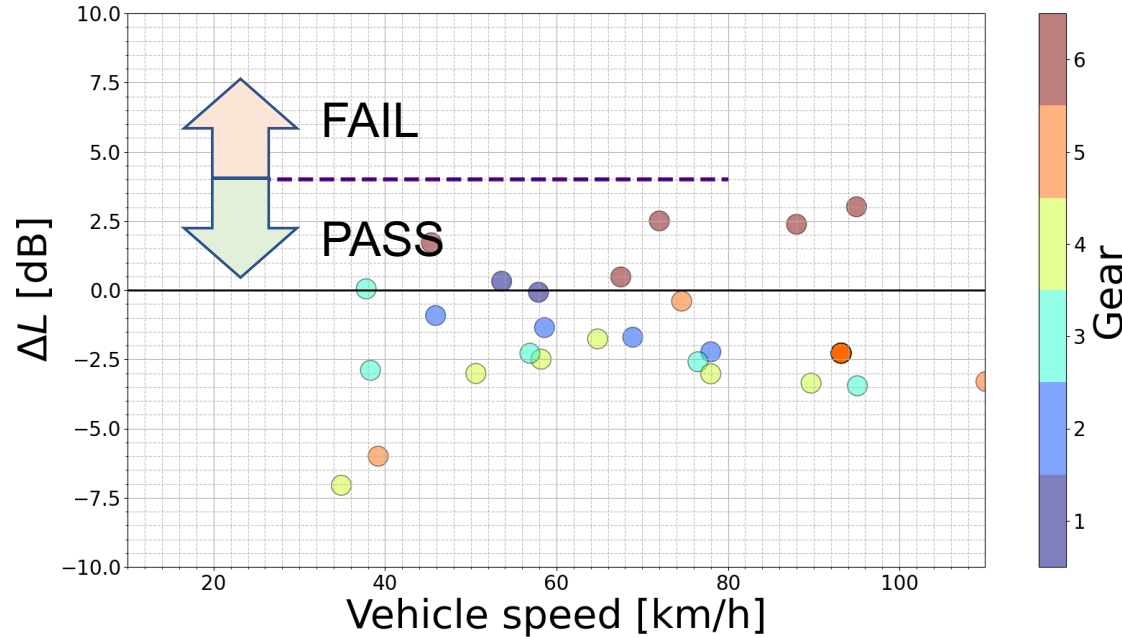


### CONCLUSIONS:

- ❖ Overall, the new model is about 3-5 dB quieter than the old model
- ❖ Quieter tyres - even with bigger size - and a quieter powertrain enable the change

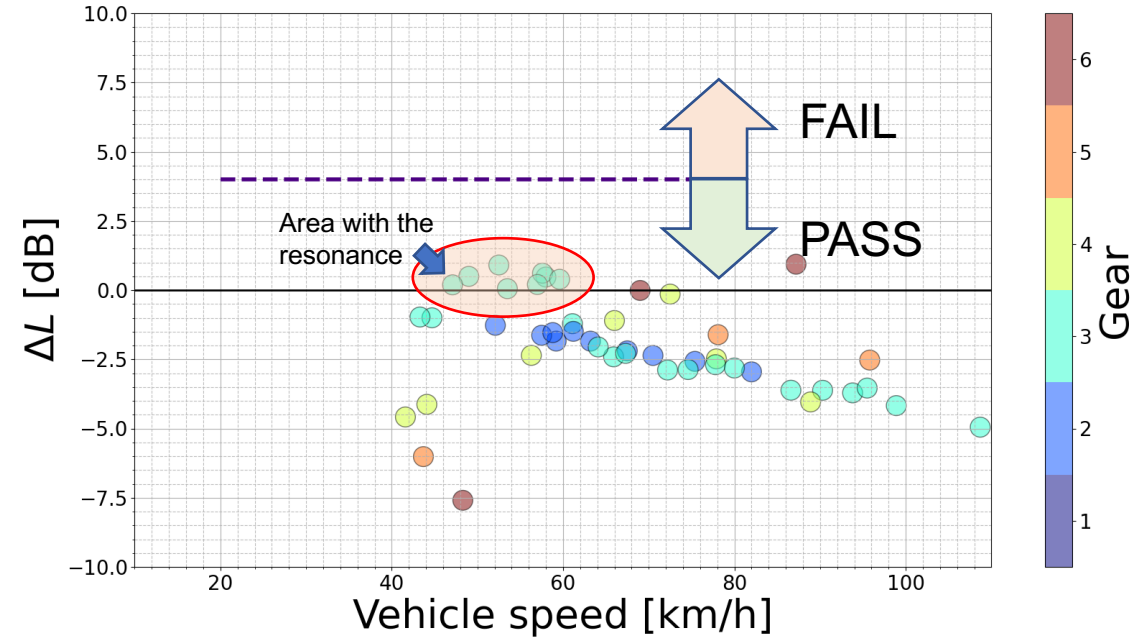
# TWIN 1: L<sub>urban</sub>-Assessment method

TWIN 1 – OLD Model



Data Source: UTAC test data, 2024

TWIN 1 – NEW Model



Data Source: UTAC test data, 2024

## FINDINGS:

- ❖ Both vehicles (old and new) can pass the  $L_{urban}$ -Assessment
- ❖ The old model is closer to the  $L_{urban}$  border.
- ❖ For the new model,  $L_{urban}$ -Assessment indicates the area of sensitivity, but the vehicle can pass the test.
- ❖ Partial load run (not shown by this graphs) can be more critical compared to full load.

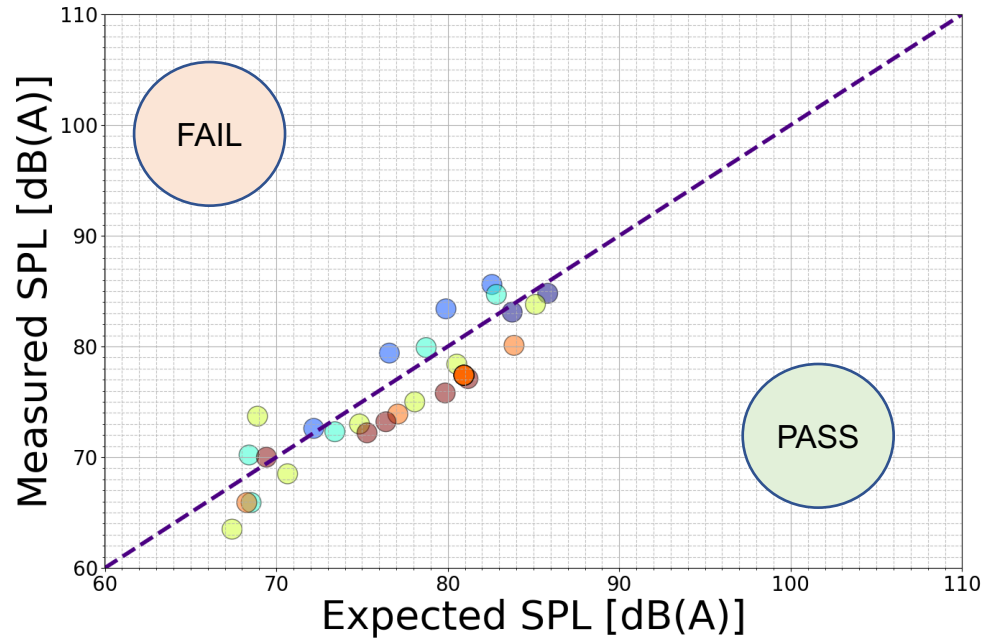


## CONCLUSIONS:

- ❖  $L_{urban}$ -Assessment is more tolerant compared to the Slope-Assessment.

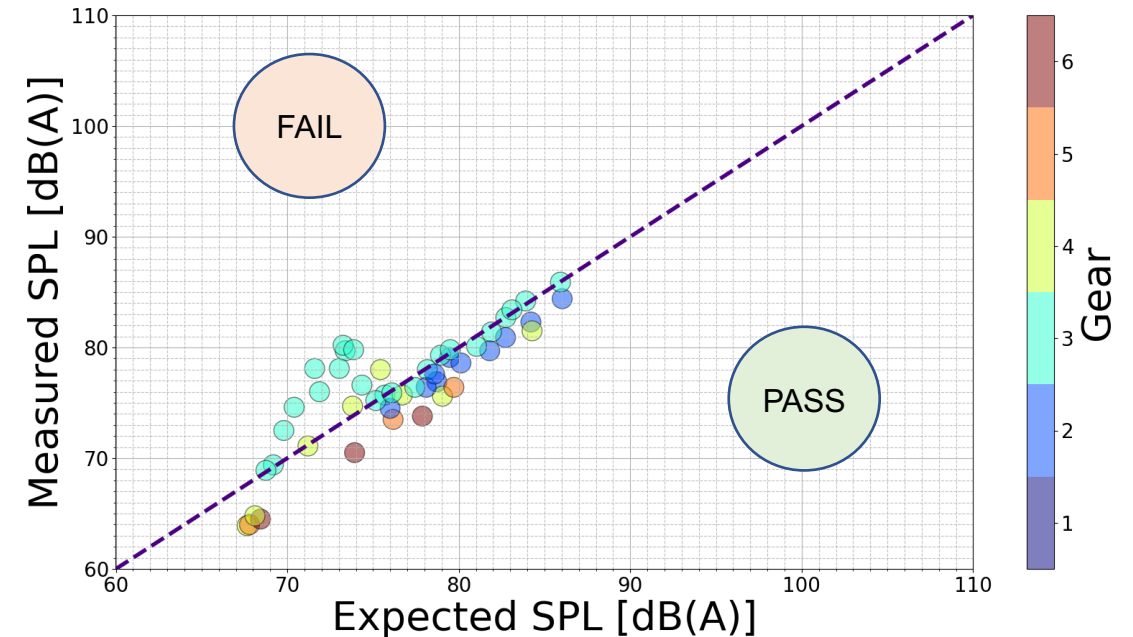
# TWIN 1: RD-ASEP comparison measurement / expectation

### TWIN 1 – OLD Model



Data Source: UTAC test data, 2024

### TWIN 1 – NEW Model



Data Source: UTAC test data, 2024

## FINDINGS:

- ❖ Both vehicles (old and new) fail RD-ASEP
- ❖ The new model could pass RD-ASEP, except of the resonance area.



## CONCLUSIONS:

- ❖ The question can be raised, whether a single resonance shall create a fail of the vehicle in type approval.
- ❖ The scope of ASEP should be to identify, if a vehicle is deviating from the type approval manner over a large – driver usable range – from the expected sound level.

# TWIN 2 – Technical Background Information

## TWIN 2 – OLD Model

General Approval Information		
Model Year	2011	
<b>Official Approval</b>	<b>UN R51.02</b>	<b>72.2 dB(A)</b>
For this study	UN R51.03	73 dB(A)

Tech. Data	Value	Unit
Engine	8 cylinder Petrol	4 163 cc
Net Power P <sub>n</sub>	331	kW
Rated Engine Speed S	8250	1/min
Curb Mass m <sub>ro</sub>	1954	kg
PMR	169	kW/t
Reference Point	Front	
Tyre Dimension	265/35 R19 98Y	
Max Vehicle Speed	250	km/h

## TWIN 2 – NEW Model

General Approval Information		
Model Year	2017	
For this study	UN R51.02	69 dB(A)
<b>Official Approval</b>	<b>UN R51.03</b>	<b>71 dB(A)</b>

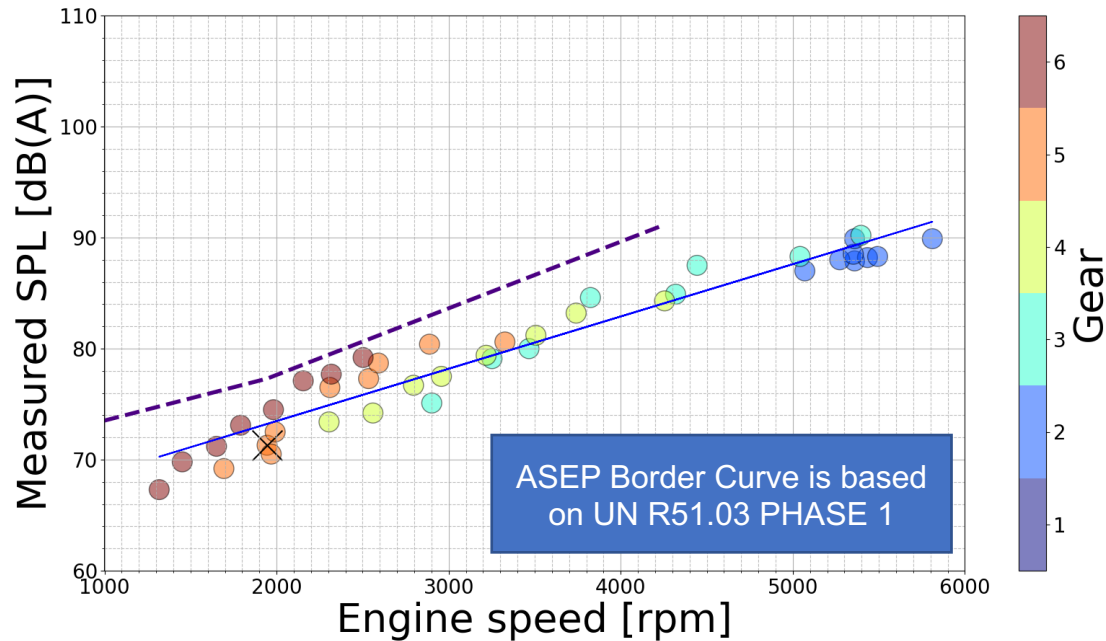
Tech. Data	Value	Unit
Engine	6 cylinder Petrol	2 894 cc
Net Power P <sub>n</sub>	331	kW
Rated Engine Speed S	6700	1/min
Curb Mass m <sub>ro</sub>	1860	kg
PMR	178	kW/t
Reference Point	Front	
Tyre Dimension	275/30 R20 97Y	
Max Vehicle Speed	250	km/h

GEAR RATIOS CALCULATED PER RUN								
AVG		12,5	18,7	22,9	30,1	39,2		
i	1	2	3	4	5	6	7	8

GEAR RATIOS CALCULATED PER RUN								
AVG		13,0	18,3	24,2	30,9			
i	1	2	3	4	5	6	7	8

# TWIN 2: ASEP Slope-Assessment method

### TWIN 2 – OLD Model



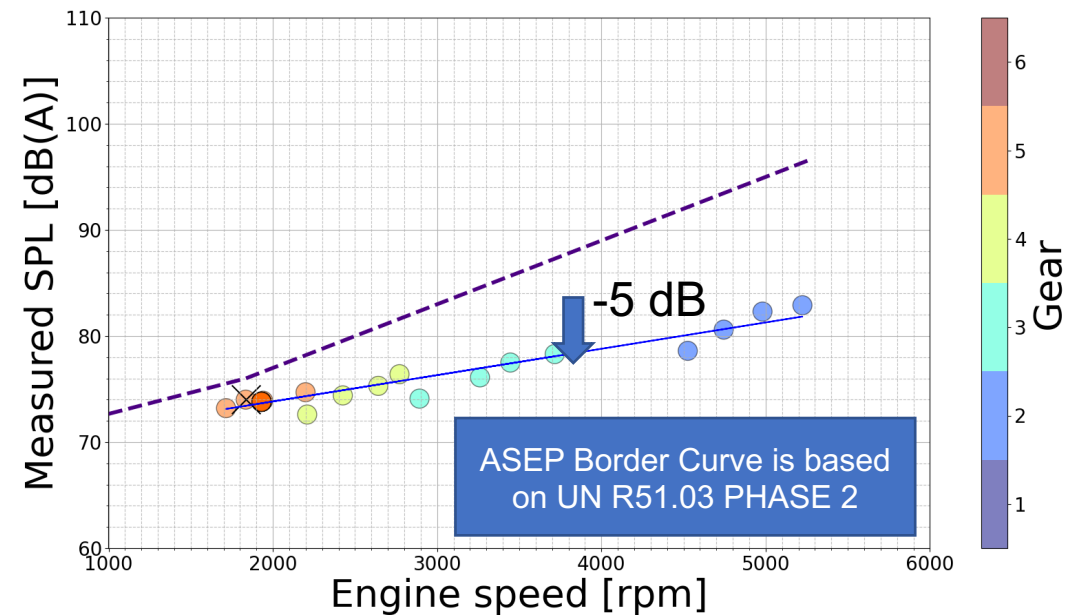
Data Source: Manufacturer Data, 2023, inhouse testing, data check by UTAC

## FINDINGS:

- ❖ The old model can pass the ASEP test.
- ❖ The orange and brown points are higher gears, which are not in the focus of ASEP today.
- ❖ The new model is very different, given by a new engine. (V6 instead of V8), despite the wheel are bigger.



### TWIN 2 – NEW Model



Data Source: Manufacturer Data, 2023, inhouse testing, data check by UTAC

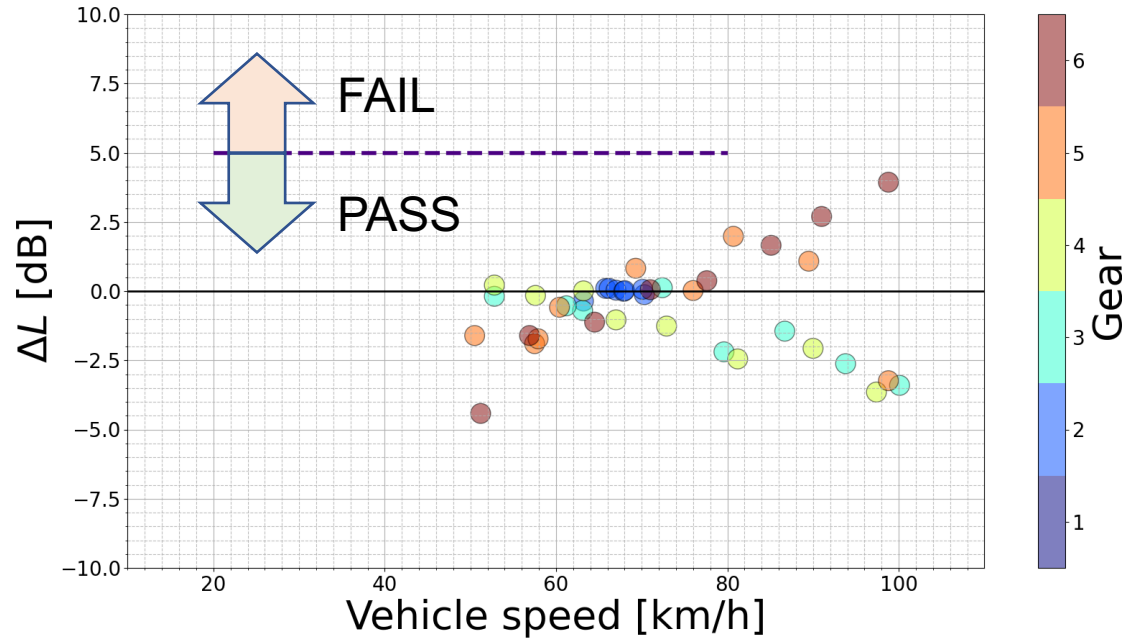
## CONCLUSIONS:

- ❖ The new model show is about 5 dB to 8 dB quieter especially towards higher engine speeds.



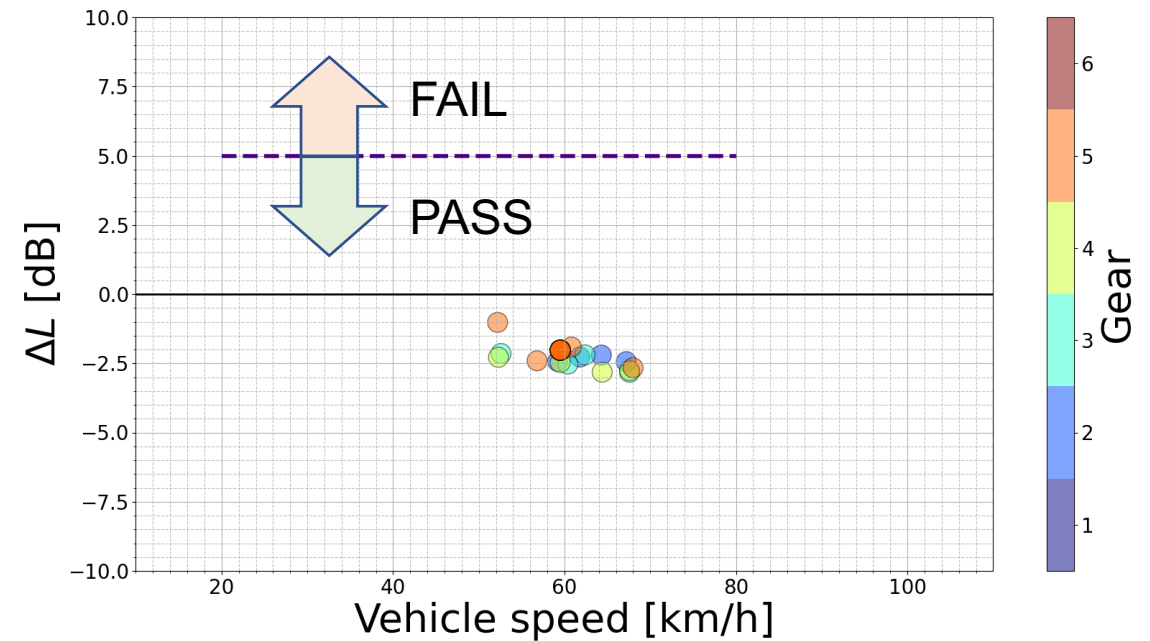
# TWIN 2: L<sub>urban</sub>-Assessment method

### TWIN 2 – OLD Model



Data Source: Manufacturer Data, 2023, inhouse testing, data check by UTAC

### TWIN 2 – NEW Model



Data Source: Manufacturer Data, 2023, inhouse testing, data check by UTAC

## FINDINGS:

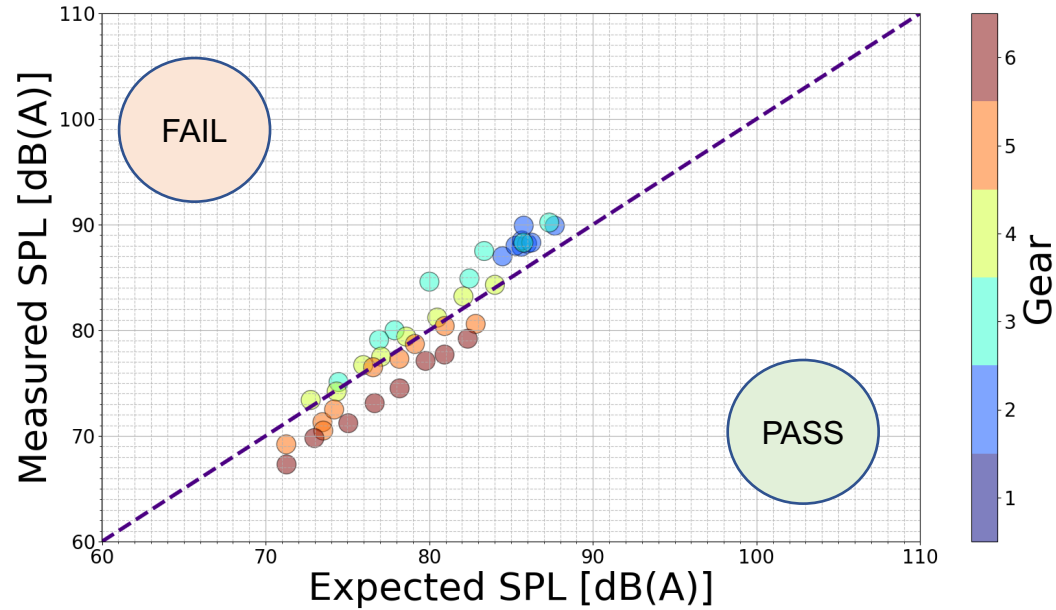
- ❖ Both vehicle comply with  $L_{urban}$ -Assessment.
- ❖ The new model is much below the ASEP border.



## CONCLUSIONS:

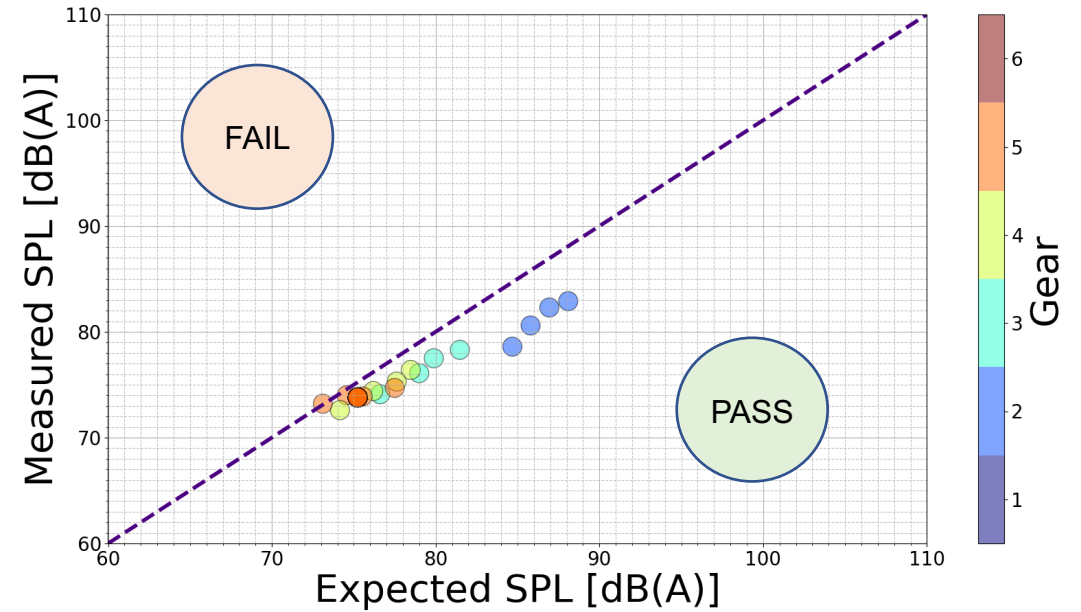
- ❖ Again, the  $L_{urban}$  method is less demanding compared to the Slope -Assessment

### TWIN 2 – OLD Model



Data Source: Manufacturer Data, 2023, inhouse testing, data check by UTAC

### TWIN 2 – NEW Model



Data Source: Manufacturer Data, 2023, inhouse testing, data check by UTAC

## FINDINGS:

- ❖ The old model cannot pass RD-ASEP in low gear over a large range, while the new model could pass RD-ASEP.
- ❖ The new model has no difficulties in passing even RD-ASEP.



## CONCLUSIONS:

- ❖ RD-ASEP is more demanding compared to the current ASEP provisions.

# TWIN 3 – Technical Background Information

## TWIN 3 – OLD Model

General Approval Information		
Model Year	2017	
<b>Official Approval</b>	<b>UN R51.02</b>	<b>74 dB(A) (Normal)</b> 96 dB(A) (Sport)
For this study	UN R51.03	71 dB(A)

Tech. Data	Value	Unit
Engine	R5 Petrol	2480 cc
Net Power P <sub>n</sub>	294	kW
Rated Engine Speed S	5850	1/min
Curb Mass m <sub>ro</sub>	1476	kg
PMR	199,2	kW/t
Transmission	AT	6 Gears
Reference Point	Front	
Tyre Dimension		
Max Vehicle Speed	250	km/h

GEAR RATIOS CALCULATED PER RUN								
AVG		14,6	21,5	29,9				
i	1	2	3	4	5	6	7	8

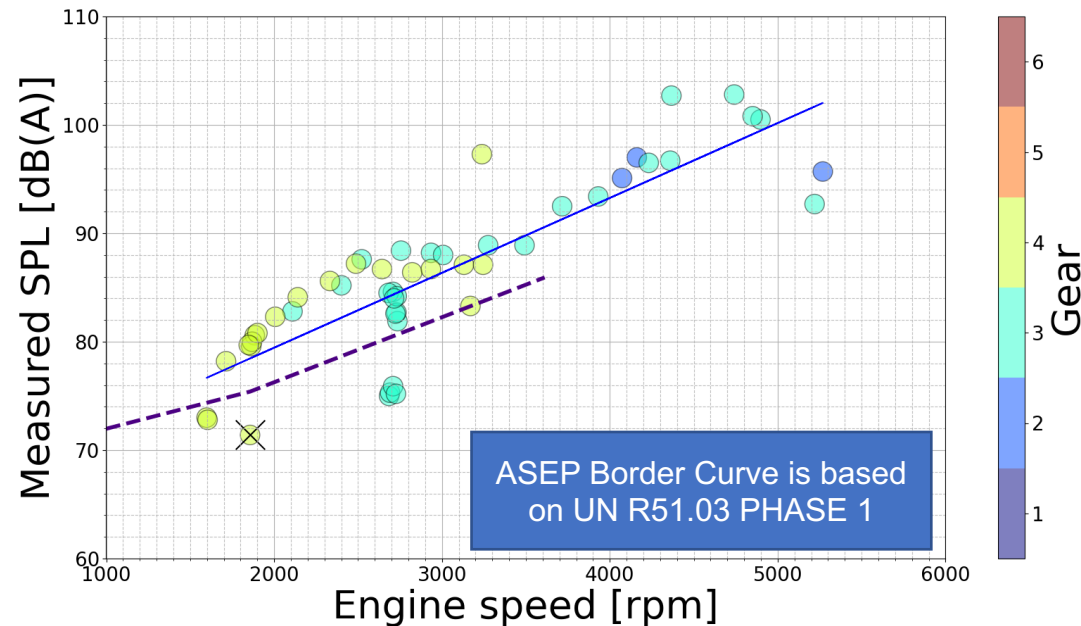
## TWIN 3 – NEW Model

General Approval Information		
Model Year	2018	Facelift of OLD Model
For this study	UN R51.02	72 dB(A)
<b>Official Approval</b>	<b>UN R51.03</b>	<b>70 dB(A)</b>

Tech. Data	Value	Unit
Engine	R5 Petrol	2480 cc
Net Power P <sub>n</sub>	294	kW
Rated Engine Speed S	7000	1/min
Curb Mass m <sub>ro</sub>	1548	kg
PMR	189,9	kW/t
Transmission	AT	7 Gears
Reference Point	Front	
Tyre Dimension	245/35 R 19 (Front)	255/30 R20 (Rear)
Max Vehicle Speed	250	km/h

GEAR RATIOS CALCULATED PER RUN								
AVG		14,2	21,3	29,3	37,5			
i	1	2	3	4	5	6	7	8

## TWIN 3 – OLD Model



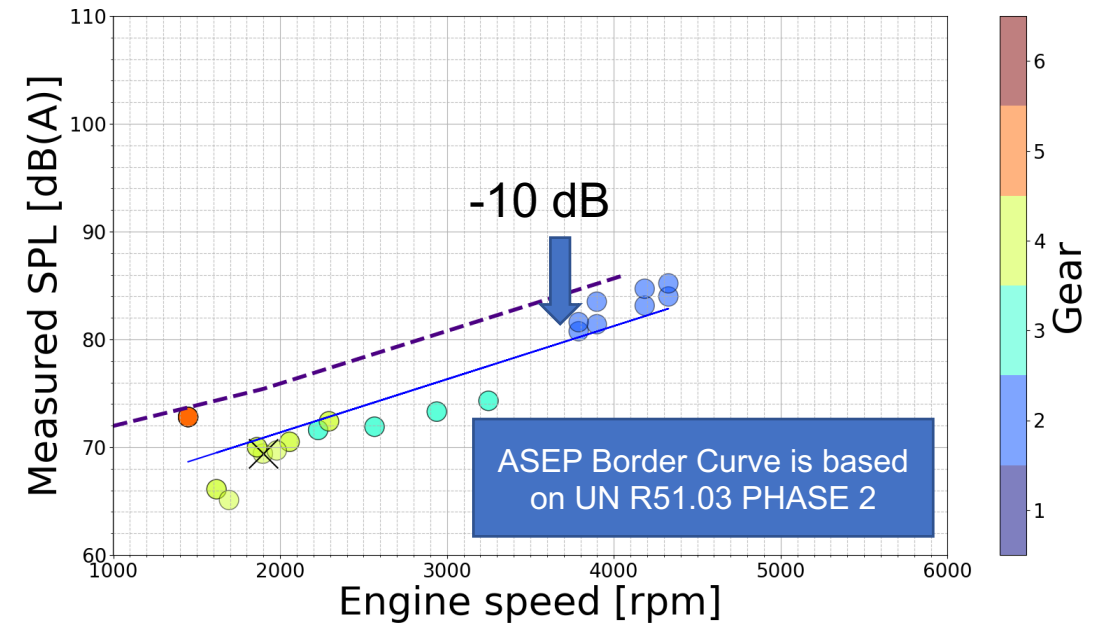
Data Source: German UBA, 2020; Forschungskennzahl 3717 54 103 0 FB000238 *Überprüfung der Geräuschemissionen von Motorrädern im realen Verkehr Abschlussbericht*

### FINDINGS:

- ❖ The old model does not comply with the ASEP Slope-Assessment (and was not forced to comply with it)
- ❖ The new model was approved under UN R51.03 phase 2 perspective and consequently complies with ASEP.
- ❖ The new model is 10 dB quieter than the old model.



## TWIN 3 – NEW Model



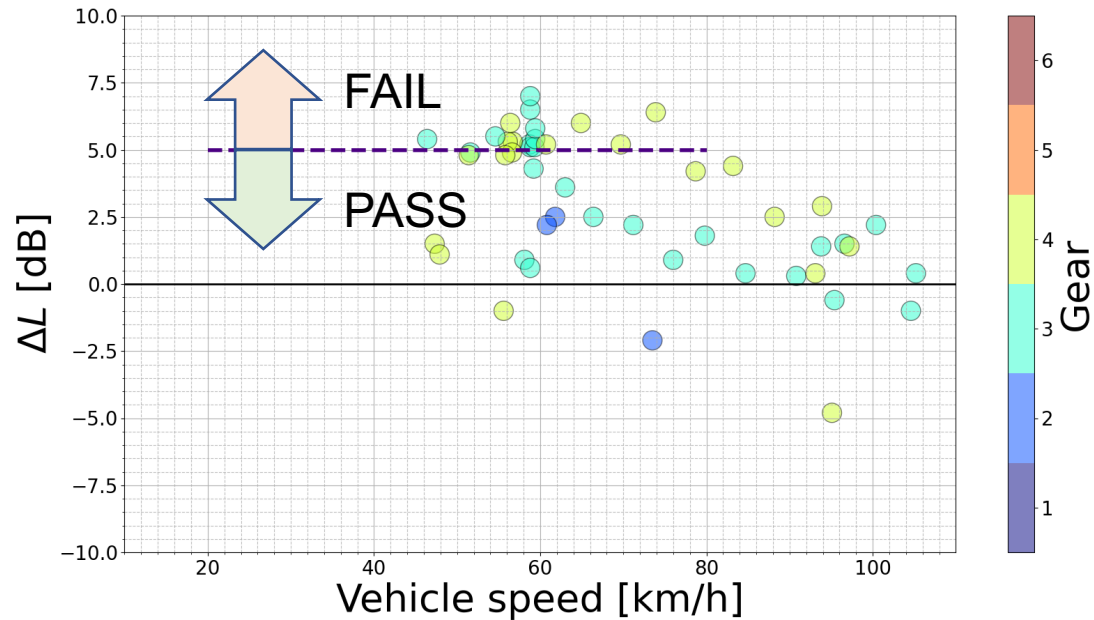
Data Source: Manufacturer Data, 2018, gained during vehicle type approval; witnessed by technical service

### CONCLUSIONS:

- ❖ Both models comply with the UN R51.03 phase 3 limit of 71 dB
- ❖ **Only Annex 3 Provisions would not have forced any re-design.**
- ❖ **The re-design of the vehicle was stipulated by the ASEP provisions of UN R51.03.**

# TWIN 3: Lurban-Assessment method

### TWIN 3 – OLD Model

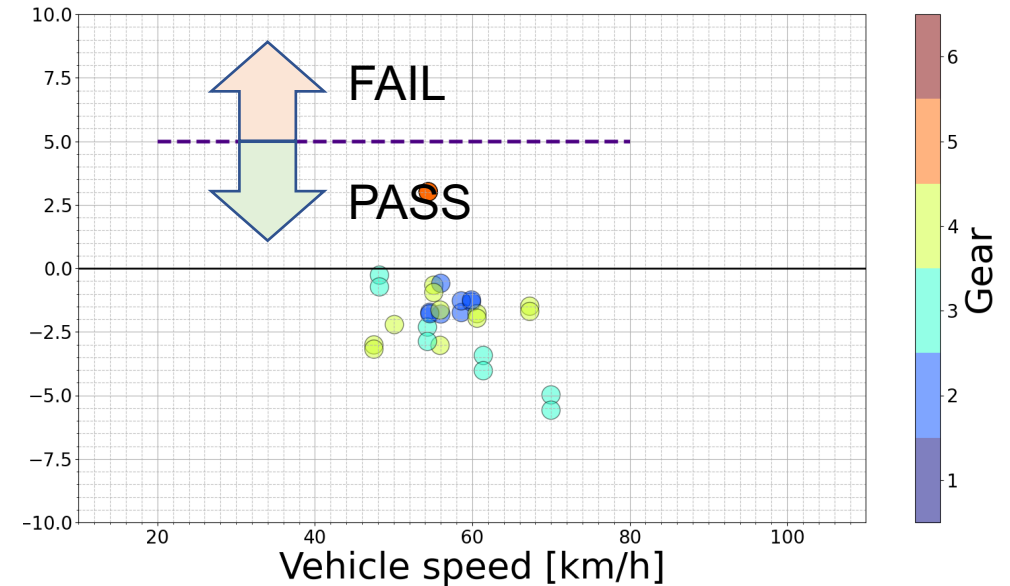


Data Source: German UBA, 2020; Forschungskennzahl 3717 54 103 0 FB000238 *Überprüfung der Geräuschemissionen von Motorrädern im realen Verkehr Abschlussbericht*

## FINDINGS:

- ❖ Same finding, the old model does not pass the Lurban-Assessment.
- ❖ But, more „pass-points“ compared to the Slope-Assessment

### TWIN 3 – NEW Model



Data Source: Manufacturer Data, 2018, gained during vehicle type approval; witnessed by technical service

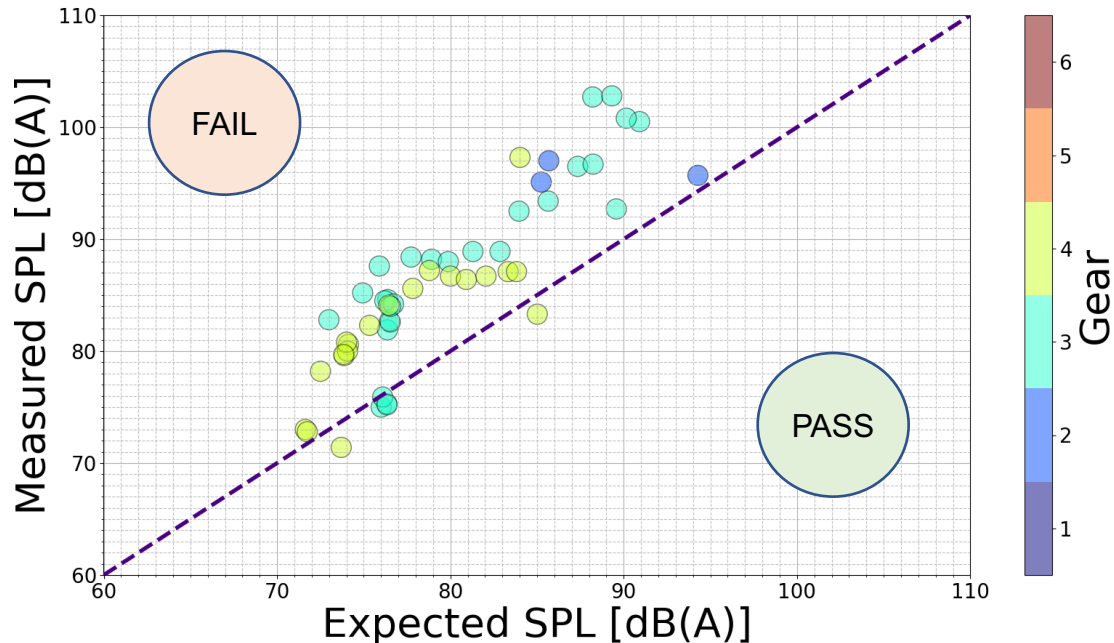
## CONCLUSIONS:

- ❖ Same conclusions as for the Slope-Assessment from the previous slide.
- ❖ Lurban is less stringent compared to the Slope-Assessment





## TWIN 3 – OLD Model

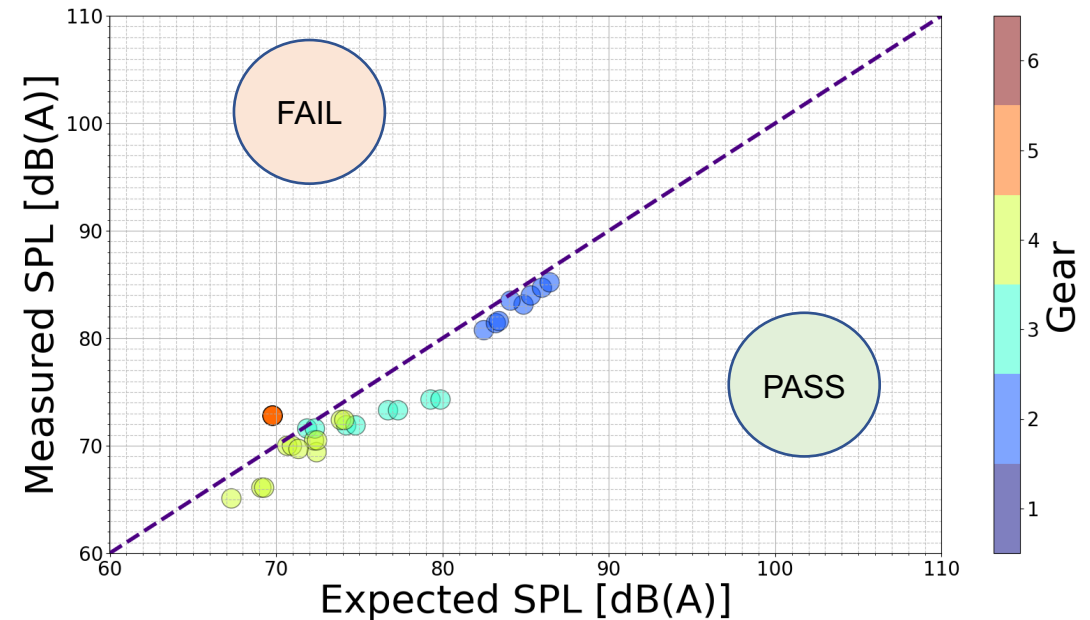


Data Source: German UBA, 2020; Forschungskennzahl 3717 54 103 0 FB000238 *Überprüfung der Geräuschemissionen von Motorrädern im realen Verkehr Abschlussbericht*

### FINDINGS:

- ❖ Only few tested points of the old model can comply with RD-ASEP (5 points)

## TWIN 3 – NEW Model



Data Source: Manufacturer Data, 2018, gained during vehicle type approval; witnessed by technical service

### CONCLUSIONS:

- ❖ Here again, RD-ASEP is most stringent to the vehicle sound performance, compared to the existing ASEP evaluation methods



## Literature Review:

- ❖ Reports on real world single event noises show, that vehicles subject to UN R51.03 ASEP have only a limited share to the overall problem.
- ❖ Press releases recognize, that newer model have less „thrilling sound“ compared to the previous model.

## Questionnaire:

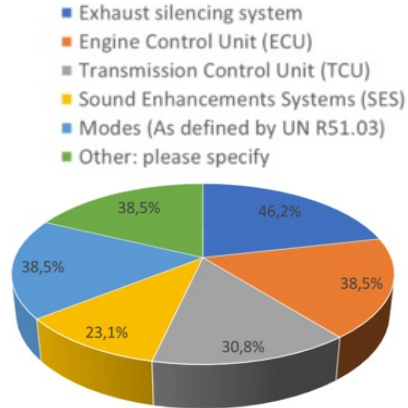
- ❖ Manufacturer report, that ASEP impacts especially high performance vehicles, forcing re-design mainly on exhaust system, ECU and TCU.
- ❖ Most manufacturers apply the guidance of the GRB-68-03 voluntarily.
- ❖ Contracting Parties confirm, that noise from single vehicles is a pending concern for citizens.
- ❖ However, for Market Surveillance exterior noise of vehicles is not systematically applied. Especially ASEP is rarely checked.

## Test Campaign:

- ❖ For all investigated TWIN, the newer models were substantially quieter compared to its previous model, even when the older model did already comply with Un R51.03 Annex 3 limits.
- ❖ The progress in sound reduction was stipulated by limits enforcement (phase 1 to phase 3) and ASEP.
- ❖ Slope-Assessment is more stringent compared to  $L_{urban}$ -Assessment.
- ❖ Upcoming RD-ASEP (status as of monitoring phase 2023/2024) will be more stringent compared to the current ASEP provisions.

## Questions asked for WP.1

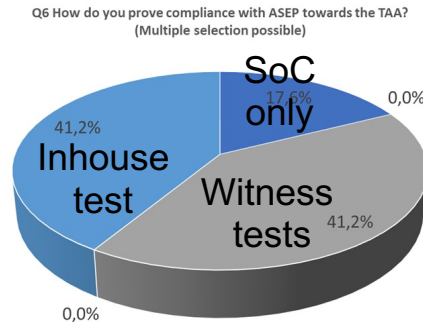
Did ASEP affect product designs?



Answers by UTAC, based on the research, questionnaire analysis and test campaign:

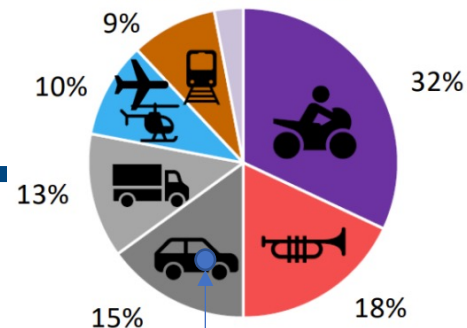
**YES**, all new models tested were substantially quieter compared to the previous model, typically 5dB to 10dB, in some cases even more

How is ASEP handled during type approval ?



ASEP compliance, by statement of compliance (SoC) based on in-house tests, or witnessed tests together with the authority.

Did ASEP lead to a remarkable release of single vehicle annoyance in real traffic?



**NO**, complains by citizens have not been reduced; other noise sources, or aspects not subject to UN R51 play a role.

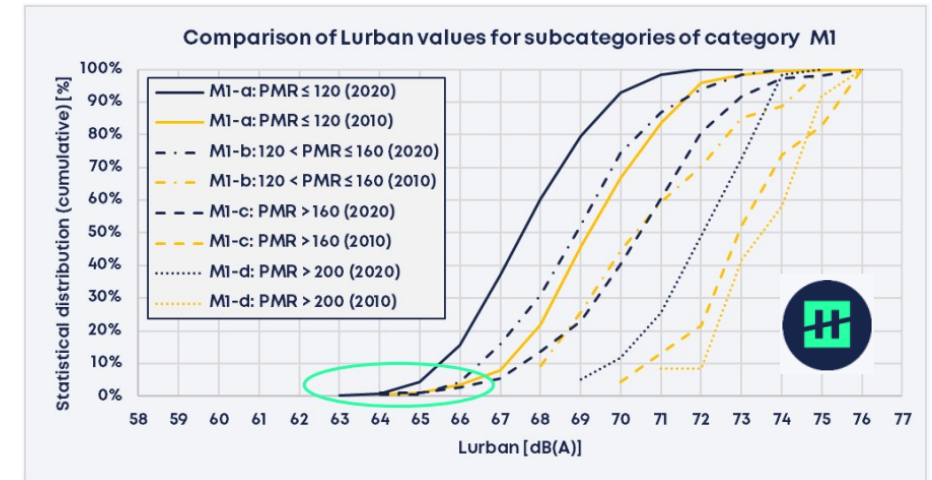
driving behaviour, manipulation, maintenance, ...

## The study has investigated in WP.1 the impact of ASEP on current vehicle technology

Conclusion in one sentence can be expressed as:

**UN R51.03 as a package of Annex 3 testing with limits in three phases, plus the specifications on ASEP (paragraph 6.2.3. of the main body plus Annex 7) has delivered significant progress on high performance vehicles.**

- Although only a limited number of vehicles were tested, maybe to few for such a general conclusion, but the result is obvious.
- The ATE EL study from 2021 on behalf of ACEA indicated already, that progress in technology for M1 vehicles was biggest for vehicles with high performance vehicles (class M1-c).
- UTAC will continue with testing a 4<sup>th</sup> TWIN, but we anticipate not significant change on the conclusions.



ATE EL study on behalf of ACEA, August 2021

### Main findings for category M1

- Mean values improvements:
  - ✓ M1-a: -1.6 dB(A)
  - ✓ M1-b: -1.5 dB(A)
  - ✓ M1-c: -2.5 dB(A)
  - ✓ M1-d: -1.5 dB(A)



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