Timeline and Explanation of Changes in GRBP/2024/22

Task from January
GRBP Subgroup on UN-R51 & UN-R 138

8-10 April 2025, Berlin

Evolution of Supplement 11

GRBP

	GRBP-78-10	GRBP-79-43	GRBP/2024/22 GRBP-80-21	81st GRBP	82nd GRBP
	1st draft address action	2nd draft rough concept	Working doc. with Revision	No document	???
	09.2023	**02.2024**	**09.2024**	**02.2025**	**09.2025**

Subgroup

12.2024	04.2025
Update of GRBP/2024/22	**Consolidated Supplement 11**
improve document	Explanation of document

Topics of Work
Evolution of Supplement 11

Main Body

1. Definition ESES
2. ASEP scope extension to EVs
3. Transitional provisions

Annex 3

4. Calibration and other corrections
5. Acceleration level for the anchor point

Annex 7

6. General - ASEP method for EVs
7. Control range
8. Virtual engine speed
9. Slope of regression line
10. Specifications

Latest Supplement 11

1. Definition ESES
Main Body of UN-R 51: Paragraph 2.29.

1st draft

Definition of ESES available in Annex 9 (Suppl. 7)

2nd draft

Definition of ESES available in Annex 9 (Suppl. 7)

Justification:
Move the already existing definition of ESES from Annex 9 to the main body of the regulation to use the definition in the whole regulation.

Working document

Move definition to main body:

"Exterior sound enhancement system (ESES)" means an active system that is installed to a vehicle for producing exterior sound, such as but not limited to AVAS according to the definition of UN Regulation No. 138, sound actuators, either integrated into an exhaust silencing system or mounted as an individual unit.

Update of WD

Keep changes

2. Extension of ASEP scope to EVs
Main Body of UN-R 51: Paragraph 6.2.3. (1)

1st draft – Exemption for „AVAS only"

The Additional Sound Emission Provisions (ASEP) apply only to vehicles of categories M1 and N1 equipped with:

- an internal combustion engine **(ICE) for propulsion of the vehicle, or**

- **any other propulsion technology, if fitted with an exterior sound enhancement system other than specified under item (d) in this paragraph. […]**

Vehicles are exempted from ASEP if one of the following conditions is fulfilled: […]

d) **For vehicles of category M1 and N1 equipped with an exterior sound enhancement system, operating as an Acoustic Vehicle Alerting System (AVAS) defined in UN Regulation No. 138 solely in the speed range specified in paragraph 6.2. of UN Regulation No. 138.**

2nd draft – Criterion-based exemption

The Additional Sound Emission Provisions (ASEP) apply ~~only~~ to vehicles of categories M1 and N1 ~~equipped with an internal combustion engine~~. […]

Vehicles are exempted from ASEP if one of the following conditions is fulfilled: […]

d) **For vehicles of category M1 or N1 with propulsion technologies other than combustion engines and equipped with exterior sound enhancement systems, operating only as an Acoustic Vehicle Alerting System (AVAS) , if**

  - **the maximum sound of the devices does not exceed the sound level of 75 dB(A) in the speed range up to and equal 50 km/h and;**

  - **the exterior sound enhancement systems are switched off at any vehicle speed higher than 50 km/h.**

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2. Extension of ASEP scope to EVs
Main Body of UN-R 51: Paragraph 6.2.3. (2)

Working Document – Refined exemption criterion

The Additional Sound Emission Provisions (ASEP) apply ~~only~~ to vehicles of categories M1 and N1 ~~equipped with an internal combustion engine~~. […] Vehicles are exempted from ASEP if one of the following conditions is fulfilled: […]

d) **For vehicles of category M1 or N1 with propulsion technologies other than combustion engines and equipped with an ESES:**

if the sound levels of the ESES under any vehicle operating condition do not exceed the following maximum sound requirements:

• 75 dB(A) at any vehicle speed below or equal to 50 km/h

• 55 dB(A) at any vehicle speed above 50 km/h

measured (at 2 m microphone distance), under the test procedures pursuant to the 02 series of amendments of UN Regulation No. 138, Annex 3, paragraph 3.3.2.

Update of WD – No more exemption

The Additional Sound Emission Provisions (ASEP) apply ~~only~~ to vehicles of categories M1 and N1 ~~equipped with an internal combustion engine~~. […]

Vehicles are exempted from ASEP if one of the following conditions is fulfilled: […(a-c)]

d) ~~For vehicles of category M1 or N1 with propulsion technologies other than combustion engines and equipped with an ESES: […] measured (at 2 m microphone distance), under the test procedures pursuant to the 02 series of amendments of UN Regulation No. 138, Annex 3, paragraph 3.3.2.~~

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2. Extension of ASEP scope to EVs
Justification

Intention:
Keeping it simple for vehicles with AVAS "only", while copying established wording of Annex 9, that already includes other propulsion technologies.

Proposed change:
- Cancel exemption d) for vehicles with AVAS "only"
- Include all propulsion technologies with clear wording.

Reasoning:
- Effort for proofing ESES as AVAS "only" is comparable to ASEP-testing.
- Exemptions always bear the risks of unwanted loopholes.

3. Transitional Provisions
Main Body, 11.6. – ASEP exemption for serial hybrids

1st draft

No changes

2nd draft

No changes

Working document

Until 30 June 2028, vehicles with a serial hybrid drive train which have a combustion engine with no mechanical coupling to the power train are excluded from the requirements of paragraph 6.2.3. above**, provided those vehicles comply with the exemptions of item (d) of paragraph 6.2.3**.

Update of Working document

Until 30 June ~~2028~~2030, vehicles with a serial hybrid drive train which have a combustion engine with no mechanical coupling to the power train are excluded from the requirements of paragraph 6.2.3. above~~, provided those vehicles comply with the exemptions of item (d) of paragraph 6.2.3~~.

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3. Transitional Provisions
Justification – Serial Hybrids

Situation:

- Serial hybrids are difficult to validate by ASEP slope assessment, since the ICE speed is not related to the actual performance of the vehicle.

Proposed change and reasoning:

- Timing changed to keep them exempted until RD-ASEP with UN-R51.04 will be introduced.
- Considering a low risk that serial hybrids can be a theoretical grey-zone.

3. Transitional Provisions
Main Body, 11.17. and 11.18. - TP's for Latest Supplements

1st draft

Supplement 10 does not apply to existing type approvals and its extensions, granted prior to the date of entry into force of Supplement 10.

2nd draft

Supplement 11 does not apply to existing type approvals and its extensions, granted prior to the date of entry into force of Supplement 11.

Working document – merge draft 1 and 2

Supplement 10 does not apply to existing type approvals and their extensions, granted prior to the date of entry into force of Supplement 10.

Supplement 11 does not apply to existing type approvals and their extensions, granted prior to the date of entry into force of Supplement 11.

Update of WD

Keep changes

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3. Transitional Provisions
Justification - Supplements

Situation:

- Supplements are not intended to change requirements, but by improving the method (e.g. temperature correction for MU) an unintended remeasurement of existing type approvals could be caused.

Proposed Change and reasoning:

- Supplements shall be applied only to future approvals (including future extensions of existing approvals).

- Existing type approvals shall be exempted to avoid the effort of remeasuring.

4. Calibration and other Corrections
Annex 3 of UN-R 51: Paragraph 1.2. and others

1st draft

Appendix 2, paragraphs 3.2.4. & 3.3.4.:

Set L_{TR} to 99% for L_{TR} is greater than 99% of L_{crs}/L_{wot}

2nd draft

No changes

Working document

~~Calibration~~ **Daily verification and adjustment** of the entire Acoustic Measurement System for a Measurement Session

At the beginning ~~and at the end~~ of every measurement session, the entire acoustic measurement system shall be checked by means of a sound calibrator of at least precision Class 1 according to IEC 60942:2003**, and - if necessary – adjusted to the reference values given by the calibrator.**

At the end of the measurement session, the entire acoustic measurement system shall be re-checked by the same calibrator which has been used for the calibration in the beginning. Without any further adjustment, the difference between the readings **at the beginning and at the end** shall be less than or equal to 0.5 dB.

If ~~this value~~ **the difference** is ~~exceeded~~ **greater than** 0.5 dB, the results of the whole measurements session ~~obtained after the previous satisfactory check~~ shall be discarded."

Update

Keep changes

4. Calibration and other Corrections
Justification

Intention:

- Clarify misunderstanding of calibration versus daily verification and adjustment of one TAA

Proposed Change and reasoning:

- Use ISO understanding/wording as it is introduced already in other regulations (e.g. UN-R138.02)

5. Acceleration-Level for the Anchor Point
Annex 3 of UN-R 51: Paragraph 3.1.2.1.4.3.

1st draft

No changes

2nd draft

No changes

WD

No changes

Update of Working document

3.1.2.1.4.3. Vehicles with only one gear ratio, like but not limited to Battery Electric Vehicles (BEV) and Fuel Cell Vehicles (FCV)

The gear selector position for forward driving shall be used. The acceleration value a_{wot} test shall be calculated […]

The achieved acceleration $a_{wot\ test}$ shall be greater or equal to a_{urban}.

If possible, the manufacturer shall take measures to avoid an acceleration value awot test greater than 2.0 m/s².

Table 1 in Appendix 1 to Annex 3 provides […]

The achieved acceleration a_{wot_test} is then used for the calculation of the partial power factor k_p (see paragraph 3.1.2.1.3.) instead $a_{wot\ ref}$.

If the acceleration value a_{wot_test} exceeds 2.0 m/s² the value $a_{wot\ test}$ for the calculation of the partial power factor k_p (see paragraph 3.1.2.1.3.) is set to 2.0 m/s².

5. Acceleration-Level for the Anchor Point
Justification

Situation:

Until now there was no need to mandate for a limited acceleration level for EVs in Annex 3.

Vehicles' drivetrain with	Annex 3: Requirements for gear selection/ acceleration level for $a_{wot\ test}$ (anchor point)	Result
3.1.2.1.4.1. **locked** gear ratios	"The following conditions for selection of gear ratios are possible: conditions a) to e)"	acceleration level defined by gear ratios conditions
3.1.2.1.4.2. **non-locked** gear ratios (CVTs)	"A gear shifting to a gear ratio which are not representative for urban traffic shall be avoided. If possible, the manufacturer shall take measures to avoid an acceleration value $a_{wot\ test}$ greater than 2.0 m/s². "	acceleration level defined by gear ratios for urban traffic
3.1.2.1.4.3. **only one** gear ratio (BEV)	"If possible, the manufacturer shall take measures to avoid an acceleration value $a_{wot\ test}$ greater than 2.0 m/s². "	**acceleration level only recommended**

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# 5. Acceleration-Level for the Anchor Point
Justification

L_{urban} is calculated by a linear interpolation of L_{crs} and L_{wot}. With the partial power factor k_p every acceleration $> a_{urban}$ can be used for calculation of L_{urban}.

$$L_{urban} = L_{wot} - k_P * (L_{wot} - L_{crs})$$

$$\text{with } k_P = 1 - (a_{urban} / a_{wot\ test})$$

Proposal and reasoning for veh. with one gear:

- By limiting the maximum acceleration $a_{wot\ test}$ to 2 m/s² in Annex 3 tests only for calculation of k_p the effects of higher accelerations are not considered in the linear interpolation of L_{urban} anymore.
- By this limitation the L_{wot} gets limited to a level related to 2 m/s².
- This approach reflects the different sound behavior of BEVs and ICEs, especially the lower dynamic of a BEV sound during acceleration/high engine load.

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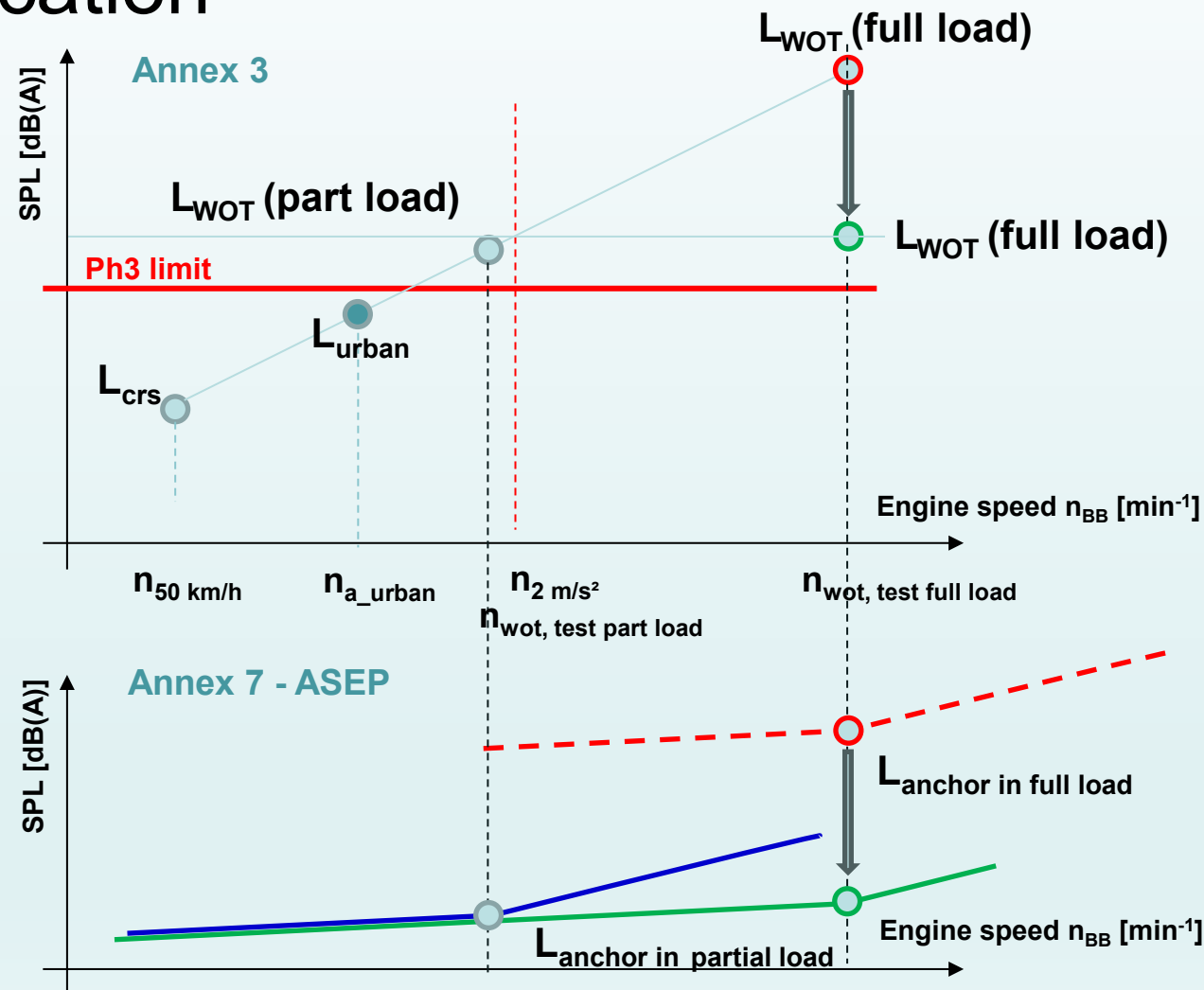
1st draft

No changes

2nd draft

Vehicles with propulsion technologies other than combustion engines, not exempted by item (d) of paragraph 6.2.3. of the main body, shall comply with Analysis method 1 only. The Analysis method 2 and the Reference sound assessment are not applicable for these vehicles.

Manufacturers of vehicles according to this paragraph shall provide a statement of compliance for ASEP based on the slope assessment only, confirming that the vehicle when tested with any acceleration up to 5m/s² does comply with the specifications described in paragraph 3.5. of this Annex.

Working Doc. – Extension to hybrids

Vehicles with propulsion technologies other than combustion engines not exempted by item (d) of paragraph 6.2.3. of the main body shall comply with Analysis method 1 **(Slope assessment method)** only.

This shall apply as well to hybrid electric vehicles tested without an operating combustion engine.

Manufacturers of vehicles according to this paragraph shall provide a statement of compliance for ASEP, confirming that the vehicle **complies with the specifications described in paragraph 3.5. of this Annex, when tested with any acceleration within the control range in paragraph 2.3.**

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Working document

Vehicles with propulsion technologies other than combustion engines not exempted by item (d) of paragraph 6.2.3. of the main body shall comply with Analysis method 1 (Slope assessment method) only.

This shall apply as well to hybrid electric vehicles tested without an operating combustion engine.

Manufacturers of vehicles according to this paragraph shall provide a statement of compliance for ASEP, confirming that the vehicle **complies with the specifications described in paragraph 3.5. of this Annex, when tested with any acceleration within the control range in paragraph 2.3.**

2nd draft – Removal of exemption

Vehicles with propulsion technologies other than combustion engines ~~not exempted by item (d) of paragraph 6.2.3. of the main body~~ shall comply with Analysis method 1 (Slope assessment method) only.

This shall apply as well to hybrid electric vehicles tested without an operating combustion engine.

Manufacturers of vehicles according to this paragraph shall provide a statement of compliance for ASEP, confirming that the vehicle complies with the specifications described in paragraph 3.5. of this Annex, when tested with any acceleration within the control range in paragraph 2.3.

6. ASEP method for EVs
Justification

Proposed change:

- Limit EVs to slope assessment, since the other methods are not suitable.
- No exemption for Hybrids.

Reasoning:

- L_{urban} method gives too big benefits for high acceleration.
- Reference Sound Assessment is meaningless, as there is too little reference data of EVs tested under R51.02

- Without an operating ICE, hybrids are comparable to pure electric vehicles.
- Only serial hybrids have been temporarily exempted by the transitional provisions (see slide 9 – missing method).

7. Control Range
Annex 7 of UN-R 51: Paragraph 2.3. (1)

1st draft	2nd draft – Extention to Evs, with no change in speed range and max. acceleration
No changes	The ASEP requirements apply to every gear ratio κ that leads to test results within the control range as defined below.

$\gg$

2nd draft – Extention to Evs, with no change in speed range and max. acceleration

Vehicle speed V_{AA_ASEP}: $v_{AA} \geq 20$ km/h
Vehicle acceleration a_{WOT_ASEP}: $a_{WOT} \leq 5.0$ m/s^2

Engine speed n_{BB_ASEP}: $n_{BB} \leq 2.0 * PMR^{-0.222} * S$ or $n_{BB} \leq 0.9 * S$, whichever is the lowest

For vehicles according to paragraph 1.1. of this annex,
- **the engine speed specifications are not applicable and**
- **the manufacturer may take measures to achieve an acceleration a_{WOT_ASEP} within the acceleration control range.**

Table 1 in Appendix 1 to Annex 3 provides examples for valid measures to enable a test condition within the above specified acceleration boundaries. Any measure used by manufacturer for the above-mentioned purposes shall be documented in the test report. […]

For vehicles tested in non-locked transmission conditions, **and for vehicles according to paragraph 1.1. of this Annex,** the maximum vehicle speed is 80 km/h.

Annex 7 of UN-R 51: Paragraph 2.3. (2)

Working document – Speed range extension down to 0 km/h

Upd.

The ASEP requirements apply to every gear ratio κ that leads to test results within the control range as defined below.

Vehicle speed V_{AA_ASEP}: $v_{AA} \geq 20$ km/h ;

$v_{AA} > 0$ km/h for vehicles according to paragraph 1.1. of this Annex

Vehicle acceleration a_{WOT_ASEP}: $a_{WOT} \leq 5.0$ m/s^2

Engine speed n_{BB_ASEP}: $n_{BB} \leq 2.0 * PMR^{-0.222} * S$ or $n_{BB} \leq 0.9 * S$, whichever is the lowest

For vehicles according to paragraph 1.1. of this annex, the engine speed specifications are not applicable. The manufacturer shall take measures to achieve an acceleration a_{WOT_ASEP} within the acceleration control range.

Table 1 in Appendix 1 to Annex 3 provides examples for valid measures to enable a test condition within the above specified acceleration boundaries. Any measure used by manufacturer for the above-mentioned purposes shall be documented in the test report. […]

For vehicles tested in non-locked transmission conditions, **and for vehicles according to paragraph 1.1. of this Annex,** the maximum vehicle speed is 80 km/h.

Keep chan-ges

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7. Control Range
Justification

Situation: A handshake at 20 km/h is difficult between R138 and R51, since the measuring methods and load conditions are different due the different scope (safety and environment) of the regulations.

Proposal: Cover maximum sound limit at 0 km/h < v_{BB} ≤ 80 km/h in UN-R51 and address maximum sound limit in standstill in R138.

Reasoning: Do not create a double regulation.
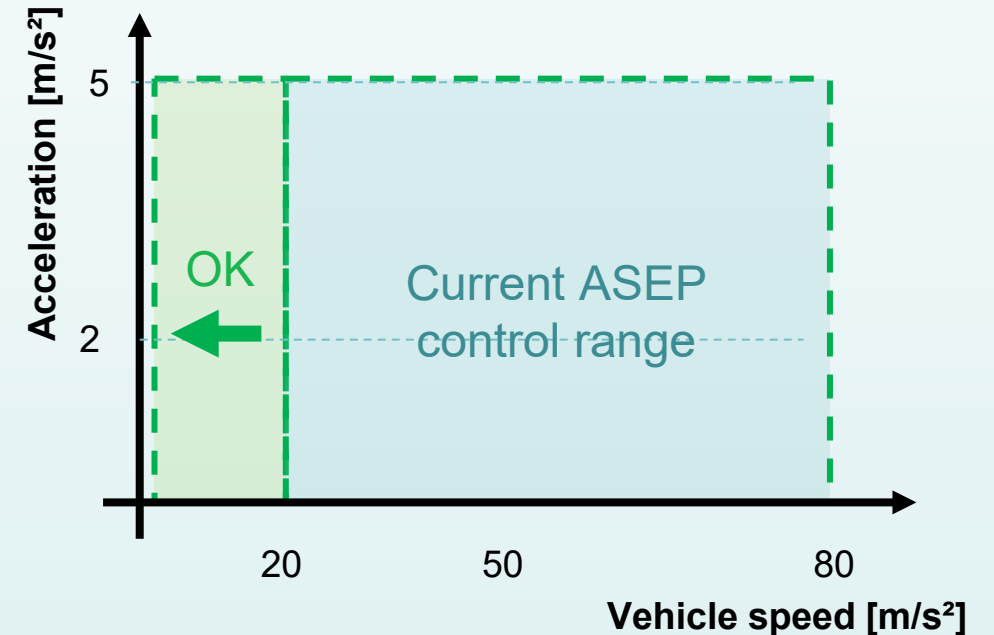
1st draft

No chan ges

≫

2nd draft – fixed gear ratio

In case of vehicles according to paragraph 1.1. of this Annex:

The engine speeds for the calculation of the slope in the paragraphs 3.2. and 3.3. is calculated from the vehicle speeds $v_{BB,\kappa j}$ by the formula

$$n_{BB,\kappa j} = 1000 * v_{BB,\kappa j}/[xx]$$

And mathematically rounded to the nearest integer.

≫

Working document – variable gear ratio

Include acceleration:

For vehicles according to paragraph 1.1. of this Annex the engine speed per test run shall be calculated by the formula below

$$n_{BB,\kappa j} = v_{BB,\kappa j}/\left(20 - 8 \times log_{10}\left(\frac{a_{test}}{a_{anchor}}\right)\right) \times 1000$$

for achieved accelerations $a_{test} > a_{anchor}$; and

$$n_{BB,\kappa j} = v_{BB,\kappa j}/20 \times 1000$$

for achieved accelerations $a_{test} \leq a_{anchor}$ with $a_{anchor} = a_{wot,test}$ of Annex 3 (average of 4 runs)

≫

Upd.

Keep chan- ges

8. Virtual Engine Speed (Anchor Point)
Annex 7 of UN-R 51: Paragraph 3.1./2.5.2.

2nd draft

Working document

In the case of vehicles according to paragraph 1.1. of this Annex:

L_{anchor} is the higher sound pressure level of L_{wot} of left and right side of gear ratio selected for the test; n_{anchor} is calculated from the average vehicle speed $v_{BB,wot}$ of the 4 runs of gear ratio selected for the test reported from Annex 3 by the formula

$$n_{anchor} = 1000 * v_{BB,wot}/[xx]$$

and mathematically rounded to the nearest integer.

In the case of vehicles according to paragraph 1.1. of this Annex:

L_{anchor} is the higher sound pressure level of L_{wot} of left and right side of gear ratio selected for the test; n_{anchor} is calculated from the average vehicle speed $v_{BB,wot}$ of the 4 runs of gear ratio selected for the test reported from Annex 3 by the formula

$$n_{anchor} = v_{BB,wot}/20 \times 1000$$

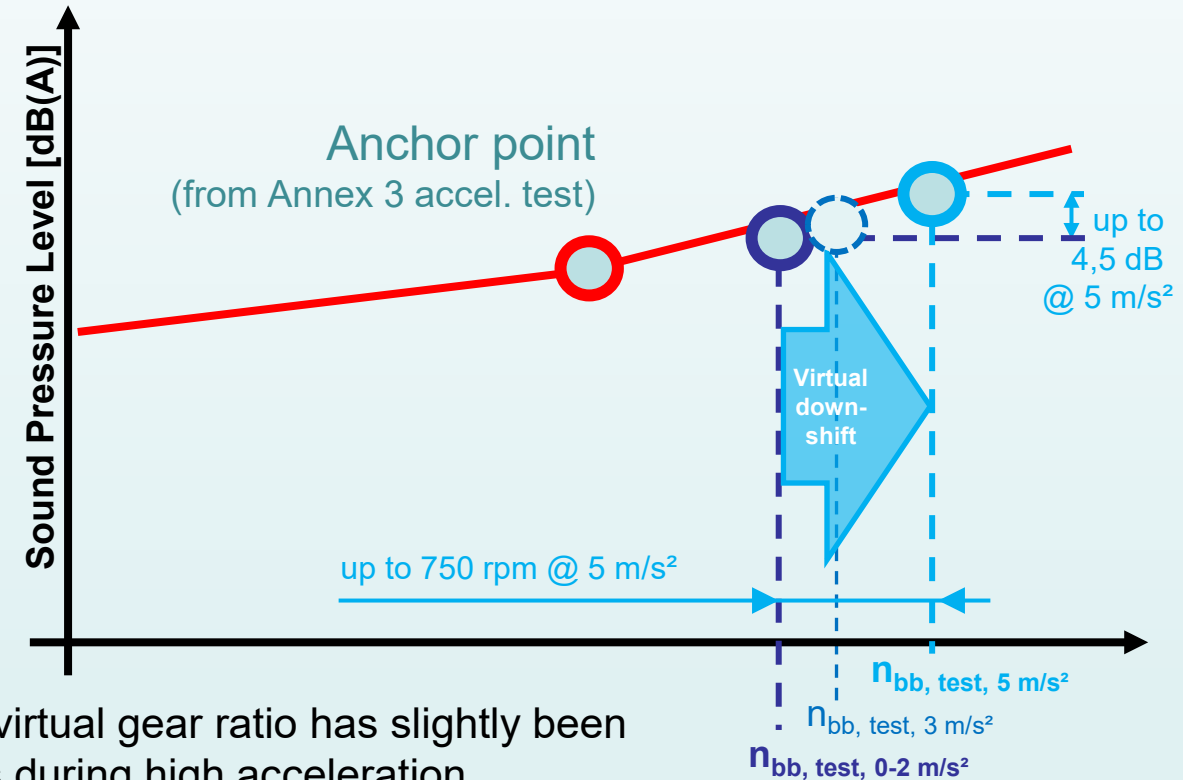and mathematically rounded to the nearest integer.

8. Virtual Engine Speed
Justification

Situation:

- The rotational speed of electric motors is not relevant for ASEP, which is based on ICE engine speed. A conversion of vehicle speed to engine rotational speed was necessary.
- Most tyres have a higher sound under acceleration (high torque applied to the tyre), and risk to penalize vehicles without an ESES.

Proposal and reasoning:

- The basic gear ratio of 20 km/h/1000rpm was chosen based on the average speed evolution of tyre sound without torque.
- An increase of torque is typically combined with a downshift to lower gears (ICE behavior).
- For EVs and only for accelerations higher than aanchor, the virtual gear ratio has slightly been modified. This moves nbb to higher rpm causing higher limits during high acceleration (> 2 m/s², typically non-urban accelerations). The graph shows the possible increase of sound during high accelerations (for a short time only).
- This improves safety with a higher level of sound during high accelerations (> 2 m/s², typically non-urban accelerations).

Sound Pressure Level [dB(A)]

Anchor point
(from Annex 3 accel. test)

up to 4,5 dB @ 5 m/s²

Virtual down-shift

up to 750 rpm @ 5 m/s²

$n_{bb, test, 5 m/s^2}$

$n_{bb, test, 3 m/s^2}$

$n_{bb, test, 0-2 m/s^2}$

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9. Slope of the Regression Line
Annex 7 of UN-R 51: Paragraph 3.2.1.

1st draft		2nd draft		Working document		Update WD
No changes	≫	**For vehicles according to paragraph 1.1 of this annex, a constant value of** $Slope_\kappa = 5\ dB/1{,}000\ min^{-1}$ **shall be considered for further calculation.**	≫	For vehicles according to paragraph 1.1 of this annex, a constant value of $Slope_\kappa = 5\ dB/1{,}000\ min^{-1}$ shall be considered for further calculation.	≫	*Keep changes*

9. Slope of the Regression Line
Justification

Situation:

- Slope$_\kappa$ is depending on the sound behavior in every gear of the vehicle (linear regression of measurements) but is limited to 5 dB/1000 rpm

  For $n_{BB\_\kappa,j} \leq n_{anchor}$:

$L_{ASEP\_\kappa,j} = L_{anchor} + (Slope_\kappa - 1) * (n_{BB\_\kappa,j} - n_{anchor}) / 1{,}000$

  For $n_{BB\_\kappa,j} > n_{anchor}$:

$L_{ASEP\_\kappa,j} = L_{anchor} + (Slope_\kappa + 1) * (n_{BB\_\kappa,j} - n_{anchor}) / 1{,}000$

Proposal and reasoning:

- Use existing tool with the most demanding limit curve for urban conditions by fixing the slope to its limit:
  - **4 dB/1000 rpm = 2 dB/10 km/h** for constant driving in urban conditions
  - **6 dB/1000 rpm = 3 dB/20 km/h** for constant driving at rural speeds
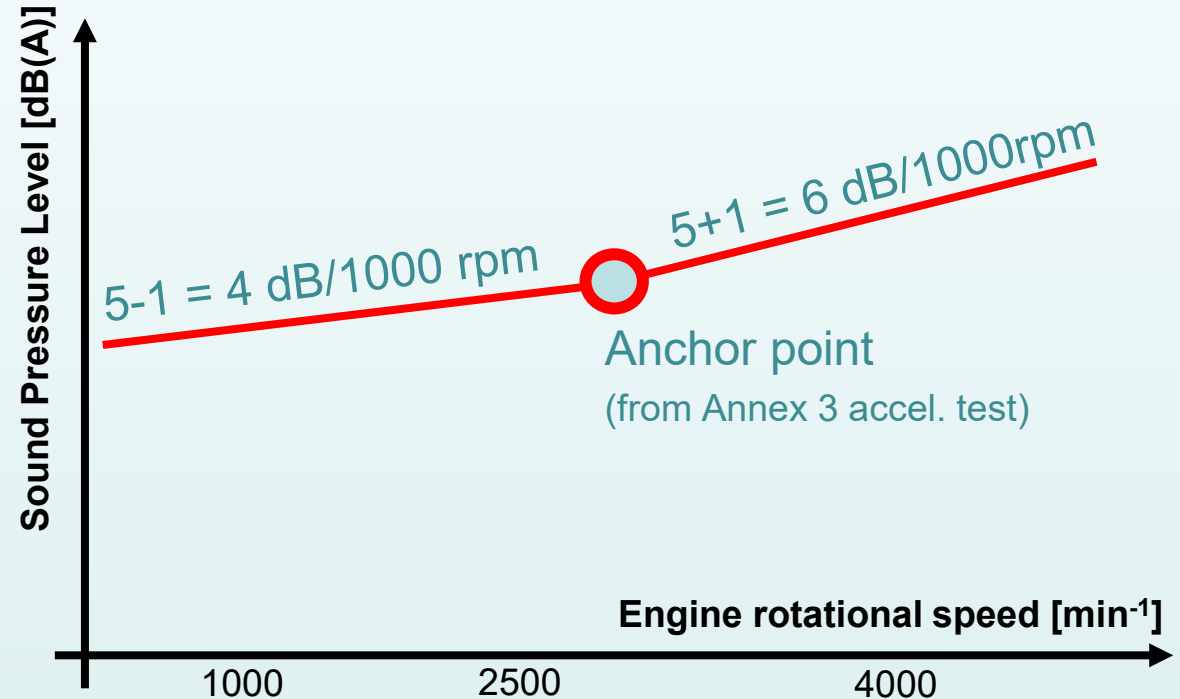
1st

No changes

2nd

No changes

Working document – Choice of margin x

The sound level of every specified measurement point shall not exceed the limits given below: $L_{\kappa j} \le L_{ASEP\_\kappa.j} + x$

With:

$x = 3$ dB~~(A)~~ + limit value - L_{urban} ~~for vehicles tested with~~

- for vehicle**s** tested with non-locked transmission conditions **given by multiple gear ratios, or**

- **for vehicles according to paragraph 1.1. of this Annex, having an L_{crs_rep} greater than L_{wot_rep} of Annex 3, or**

- **for vehicles according to paragraph 1.1. of this Annex, having multiple electric propulsion sources**

$x = 2$ dB~~(A)~~ + limit value - L_{urban} of Annex 3 for all other vehicles

If the measured sound level at a point exceeds the limit, two additional […]

Update of WD - only wording

[…]
$x = 3$ dB~~(A)~~ + limit value - L_{urban} ~~for vehicles tested with~~

- for vehicle**s** tested with non-locked transmission conditions given by multiple gear ratios, or

- for vehicles ~~according~~ **subject** to paragraph 1.1. […]

- for vehicles ~~according~~ **subject** to paragraph 1.1. […]

If **at any point** the measured sound level ~~at a point~~ exceeds the limit, two additional […]   28

10. Specifications
Justification

Situation:

- For ICEs ASEP limit curves are based on measurements in every gear averaged by linear regression versus engine speed. Every measurement in the control range is compared to this average plus an accepted dispersion x.

$$\text{``}L_{\kappa j} \leq L_{ASEP\_\kappa.j} + x\text{''}$$

- x consists of the difference of L_{urban} to the limit value (Annex 3) and an additional margin for nonlinear behavior.

  "$x = 3$ dB + limit value - L_{urban} for vehicle**s** tested with non-locked transmission conditions **given by multiple gear ratios**
  $x = 2$ dB + limit value - L_{urban} for all other vehicles"

Proposal and reasoning:

- For EVs the same requirements are kept, using the most demanding limit curve for urban conditions (slope fixed).
- For EVs the "additional margin for nonlinear behavior" needs additional description:
  - unusual, extreme nonlinear behavior: SPL in cruising condition (L_{crs_rep}) is higher than in accelerated condition (L_{wot_rep}) has been experienced with the introduction of Supplement 7
  - multiple electric propulsion sources are comparable to ICEs with non-locked transmissions conditions

  "$x = 3$ dB + limit value - L_{urban} **for vehicles subject to paragraph 1.1. of this Annex,**
  - having an L_{crs_rep} greater than L_{wot_rep} of Annex 3, or
  - having multiple electric propulsion sources"

Additional Working Packages
Reflect Discussion in Subgroup

- ➤ change limit curve from virtual rpm based to a speed related curve
  - ▪ Translate fixed gear ratio in speed
    - → implement acceleration headroom based on speed
- ➤ Implement a maximum limit in UN R138
  - ▪ for out of ASEP-scope areas:
    - – for standstill condition
    - – for vehicles of category M2,M3, N2 and N3 only
  - ▪ as a backup limit for ASEP areas?
    - – for M1 and N1 while avoiding double regulation
- ➤ Avoid strange sounds in UN-R138
  - ▪ Funny sounds (Animals sound, etc.)
  - ▪ Intermitting/modulating sounds