

Transmitted by the expert
from the Netherlands

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World Forum for Harmonization of Vehicle Regulations

Working Party on Noise

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Item xx of the provisional agenda

REGULATION No. 51
(Noise of M and N categories of vehicles)

Proposal for amendments to Regulation No. 51

Submitted by the expert from the Netherlands */

The proposal reproduced below was prepared by the expert from the Netherlands. It contains a draft proposal for changes to the text of method B specified in Regulation No. 51 - Revision 1 - Amendment 3 in order to incorporate Additional Sound Emission Provisions (ASEP). ASEP are assumed to be added as Annex 10, while the type approval method is assumed to be described in Annex 3. The numbering of annexes deviates from Regulation No. 51 - Revision 1 - Amendment 3 in which Annex 10 is used for method B.

*/ In accordance with the programme of work of the Inland Transport Committee for 2006-2010 (ECE/TRANS/166/Add.1, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance performance of vehicles. The present document is submitted in conformity with that mandate.

This proposal is an update of an earlier proposal by the Netherlands (ECE-TRANS-WP29-GRB-2009-05e). The reason for the update are given in the justification under part B. The full text proposal is given under part A. The deviations of this text to earlier proposals is given under part C.

A. TEXT PROPOSAL

Main body

Insert a new paragraph 2.19., to read:

- 2.19. “A defeat device” is any operational strategy or design feature whose purpose is to artificially reduce the sound emission within, or artificially increase sound emission outside, the test conditions as laid down in this regulation.

Amend to read

6.2.3. Additional sound emission provisions

6.2.3.1. scope and exemptions

Note: The text in paragraph 6.2.3.1. contains several options to exclude certain vehicles from ASEP as they were discussed in the ASEP IG (N1, CVT, hybrid). This text may need fine tuning and discussion in GRB as it was not yet agreed in the ASEP IG.

The additional sound emission provisions are preventive requirements. The purpose of these requirements is to ensure that the sound emission of the vehicle under typical driving conditions different from the conditions of the type approval test in Annex 3 shall not deviate considerably from what can be expected from the Annex 3 test result for this specific vehicle.

The additional sound emission provisions apply only to vehicles of categories M1 and N1 equipped with an internal combustion engine.

Vehicles are deemed to fulfill the requirements of annex 10, if the vehicle manufacturer provides technical documents to the type approval authority showing, that the difference between maximum and minimum of the vehicles engine speed at BB' for any test condition inside the ASEP control range defined in 3.3. below (including Annex 3 conditions) does not exceed $0.15 \times S$. This article is intended especially for non-lockable CVT's.

It is not applicable

6.2.3.1.1 For Vehicles of category N1 with a GVW > 2.5t with

the driver position 'R-point' is either forward of the front axle or longitudinally rearwards of the front axle transverse centreline by a maximum of [1150] mm

and

the highest reported engine speed in the annex 3 test is \geq [?]% of S

6.2.3.1.2 For vehicles of category N1 with a GVW \leq 2.5t GVW with

payload \geq 850 kg and PMR \leq 40 kw/t

or

an engine capacity up to 660 ccm and a PMR \leq 35 kw/t

or

where the highest reported engine in the Annex 3 is \geq 90% of the control range as defined in the control range of Annex 10

6.2.3.1.3 Vehicles with a hybrid drive train which have an internal combustion engine with no mechanical coupling to the power train are excluded from ASEP for a period of 5 years after entering into force of this regulation.

6.2.3.2. Defeat devices and cycle detection

6.2.3.2.1. [Defeat devices are not permitted]

6.2.3.2.2. [The vehicle manufacturer shall not intentionally alter, adjust, or introduce any mechanical, electrical, thermal, or other device or procedure solely for the purpose of fulfilling the noise emission requirements as specified in this regulation and as determined by the test procedure of Annex 3 but which will not be operational [during typical on-road operation] [over the speed range of the vehicle]. These measures are commonly referred to as "cycle detection".]

6.2.3.3. The vehicle shall meet the requirements of annex 10

6.2.3.4. In the application for type approval the manufacturer shall provide a statement (in conformity with Appendix 1 of annex 10) that the vehicle type to be approved complies with the requirements of paragraph 6.2.3 of this Regulation.

8. CONFORMITY OF PRODUCTION

The conformity of production procedures shall comply with those set out in the Agreement, Appendix 2 (E/ECE/324-E/ECE/TRANS/505/Rev.2) with the following requirements:

- 8.1. Vehicles approved to this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements set forth in paragraph 6. above. The limit values set forth in paragraph 6 and referenced appendices apply with an additional margin of 1 dB(A).
- 8.2. The minimum requirements for conformity of production control procedures set forth in Annex 7 to this Regulation shall be complied with.
- 8.3. The authority which has granted type approval may at any time verify the conformity control methods applied in each production facility. The normal frequency of these verifications shall be one every two years.

Annex ??Methods and instruments for measuring the noise made by motor vehicles
(Measurement Method B)

Paragraph 3.1.2.1.4, amend to read:

3.1.2.1.4.1. Vehicles with manual transmission, automatic transmissions, adaptive transmissions or CVT's tested with locked gear ratios

The following conditions for selection of gear ratios are possible:

- (a) If one specific gear ratio gives an acceleration in a tolerance band of ± 5 per cent of the reference acceleration $a_{wot\ ref}$, ~~not exceeding $2.0\ m/s^2$~~ , test with that gear ratio.
- (b) If none of the gear ratios give the required acceleration, then choose a gear ratio i , with an acceleration higher and a gear ratio $i+1$, with an acceleration lower than the reference acceleration. ~~If the acceleration value in gear ratio i does not exceed $2.0\ m/s^2$, use both gear ratios for the test.~~ The weighting ratio in relation to the reference acceleration $a_{wot\ ref}$ is calculated by:

$$k = (a_{wot\ ref} - a_{wot\ (i+1)}) / (a_{wot\ (i)} - a_{wot\ (i+1)})$$
- ~~(c) — if the acceleration value of gear ratio i exceeds $2.0\ m/s^2$, the first gear ratio shall be used that gives an acceleration below $2.0\ m/s^2$ unless gear ratio $i+1$ provides acceleration less than a_{urban} . In this case, two gears, i and $i+1$ shall be used, including the gear i with acceleration exceeding $2.0\ m/s^2$. In other cases, no other gear shall be used. The achieved acceleration $a_{wot\ test}$ during the test shall be used for the calculation of the part power factor k_p instead of $a_{wot\ ref}$.~~
- (c ~~d~~) If the vehicle has a transmission in which there is only one selection for the gear ratio the acceleration test is carried out in this vehicle gear selection. The achieved acceleration is then used for the calculation of the part power factor k_p instead of $a_{wot\ ref}$.
- (d ~~e~~) If rated engine speed is exceeded in a gear ratio before the vehicle passes BB' the next higher gear shall be used.

3.1.2.1.4.2. Vehicles with automatic transmission, adaptive transmissions and CVT's tested with non-locked gear ratios:

The gear selector position for full automatic operation shall be used.

The acceleration value $a_{wot\ test}$ shall be calculated as defined in paragraph 3.1.2.1.2.2.

The test may then include a gear change to a lower range and a higher acceleration. A gear change to a higher range and a lower acceleration is not

allowed. A gear shifting to a gear ratio which is not used in urban traffic shall be avoided.

Therefore, it is permitted to establish and use electronic or mechanical devices, including alternate gear selector positions, to prevent a downshift to a gear ratio which is typically not used at the specified test condition in urban traffic.

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

~~If possible, the manufacturer shall take measures to avoid an acceleration value $a_{\text{wot test}}$ greater than 2.0 m/s^2 .~~

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

Annex 7

CHECKS ON CONFORMITY OF PRODUCTION

1. General

These requirements are consistent with the test to be held to check conformity of production according to paragraph 8. of this Regulation.

2. Testing procedure

The test site and measuring instruments shall be those as described in Annex 3.

2.1. The vehicle(s) under test shall be subjected to the test for measurement of sound of vehicle in motion as described in paragraph 3.1. of Annex 3.

2.2. Compressed air sound

Vehicles having maximum mass exceeding 2,800 kg and equipped with compressed air systems must be subjected to an additional test for measurement of the compressed air sound as described in paragraph 1. of Annex 6.

2.3 Additional Sound Emission Provisions.

The vehicle manufacturer shall assess the compliance with ASEP by an appropriate evaluation (for example, but not limited to, part checks) or may perform the test described in Annex 10.

3. Sampling and Evaluation of the results

One vehicle has to be chosen and subjected to the tests of paragraph 2 above. If the test results fulfill the COP requirements of paragraph 8 of the main body of this regulation, the vehicle is considered to be in compliance with the COP provisions.

If one of the test results does not fulfill the COP requirements of paragraph 8 of the main body of this regulation two more vehicles of the same type shall be tested pursuant to paragraph 2 above.

If the test results for the second and the third vehicle fulfill the COP requirements of paragraph 8 of the main body of this regulation, the vehicle is considered in compliance with COP.

If one of the test results of the second or third vehicle does not fulfill the COP requirements of paragraph 8 of the main body of this regulation the vehicle type shall be considered not to conform to the requirements of this Regulation and the manufacturer shall take the necessary measures to re-establish the conformity.

Annex 10

MEASURING METHOD TO EVALUATE THE COMPLIANCE WITH THE ADDITIONAL SOUND EMISSION PROVISIONS only applicable for vehicles of categories M1 and N1 which are equipped with an internal combustion engine

1. INTRODUCTION

This annex describes a measuring method to evaluate the compliance of the vehicle with the additional sound emission provisions conform paragraph 6.2.3. of this regulation. The expected noise emission in a particular gear ratio is approximated by a linear function of engine speed. The anchor point of this linear function is based on the test results of annex 3.

Although the vehicle shall meet the requirements in this annex, it is not obligatory to perform actual tests when applying for type approval. It is obligatory for the manufacturer to sign a declaration of compliance conform Appendix 1 to this annex. The type approval authority shall have the possibility to ask for additional information about the declaration of compliance and/or carry out the tests as described below.

The analysis of Annex 10 requires the performance of a test according to Annex 3. This Annex 3 test has to be performed under similar conditions on the same track as the tests according to Annex 10.

2. MEASURING METHOD

2.1 measuring instruments and condition of measurements

Unless specified differently here after, the measuring instruments, the conditions of the measurements and the condition of the vehicle are equal to those specified in Annex 3 paragraph 1 and 2.

If the vehicle has different modes that affect sound emission, all modes shall comply with the requirements in this annex. In the case the manufacturer has performed tests to prove to the approval authority compliance with the above requirements, the modes used during those tests shall be reported in the test report shown in appendix 2 to Annex 10.

2.2. Method of testing

Unless specified differently here after, the conditions and procedures of Annex 3 paragraph 3.1 until 3.1.2.1.2.2. shall be used.

Differing from Annex 3, single measurements are processed and evaluated.

2.3 Control range

There is a range of valid operation conditions which have to fall within the following boundary conditions:

Vehicle speed V_{AA_ASEP} :	$v_{AA} \geq 20 \text{ km/h}$
Vehicle acceleration aWOT ASEP:	$a_{WOT} \leq 5,0 \text{ m/s}^2$
Engine speed n_{BB_ASEP} :	$n_{BB} \leq 2,0 \text{ *rpm}^{-0,222} \text{ *s}$ or $n_{BB} \leq 0,9 \text{ *s}$ whichever is the lowest

Vehicle speed V_{BB_ASEP} :	
if n_{BB_ASEP} is reached in one gear	$v_{BB} \leq 70 \text{ km/h}$
in all other cases	$v_{BB} \leq 80 \text{ km/h}^*$
gears	$k \leq \text{highest gear measured in Annex 3}$ [k not first gear]

* If the vehicle, in the lowest valid gear, does not achieve the maximum engine speed below 70 km/h, the vehicle speed limit is 80 km/h

2.4 Gear ratios

The ASEP requirements apply to every gear ratio k that leads to test results within the control range as defined in paragraph 2.3 in this Annex.

In case of vehicles with automatic transmissions, adaptive transmissions and CVT's tested with non-locked gear ratios, the test may include a gear ratio change to a lower range and a higher acceleration. A gear change to a higher range and a lower acceleration is not allowed. A gear shifting which leads to a condition that is not in compliance with the boundary conditions shall be avoided. In that case, it is permitted to establish and use electronic or mechanical devices, including alternate gear selector positions.

2.5 Test of the vehicle

The path of the centerline of the vehicle shall follow line CC' as closely as possible throughout the entire test, from the approach to line AA' until the rear of the vehicle passes line BB'

Before line AA' the accelerator shall be operated to a stable position, leading to a valid acceleration as defined in paragraph 2.3 above. The accelerator must not necessarily be fully depressed, as also partial throttle tests may be checked for compliance with the limit curve as defined in paragraph 3.3. The accelerator shall be kept in this stable position until the rear of the vehicle reaches line BB'

For every separate test run the following parameters shall be determined and noted:

- The maximum A-weighted sound pressure level of the both sides of the vehicle indicated during each passage of the vehicle between the two lines AA' and BB', mathematically rounded to the first decimal place. ($L_{wot,kj}$). If a sound peak obviously out of character with the general sound pressure level is observed, the measurement shall be discarded. Left and right side may be measured simultaneously or separately.
- The vehicle speed readings at AA' and BB' shall be reported with the first significant digit after the decimal place. ($v_{AA,kj}$; $v_{BB,kj}$)
- If applicable, the engine speed readings at AA' and BB' shall be reported as a full integer value. ($n_{AA,kj}$; $n_{BB,kj}$)

The calculated acceleration shall be determined in accordance to the formulas in annex 3 par 3.1.2.1.2 and reported to the second digit after the decimal place ($a_{wot,test,kj}$).

A test run is valid only if the measured vehicle performance and operation conditions fall inside the ASEP control range specified in paragraph 2.3. above

3. NOISE LIMITATION

The maximum A-weighted sound pressure level recorded during a test run as specified above shall not exceed the limit curve defined below.

3.1. Anchor point

The anchor point is defined in terms of vehicle speed and sound pressure level.

The vehicle speed of the anchor point, v_{anchor} , is the effective vehicle speed at BB' of the acceleration test in Annex 3. In the case of a single gear test in gear i the vehicle speed of the anchor point is:

$$v_{anchor} = v_i$$

In the case of a two-gear test in gears i and $i+1$ the vehicle speed of the anchor point is the weighted average of the vehicle speeds in both gears, namely

$$v_{anchor} = v_{i+1} + k*(v_i - v_{i+1}),$$

where k is the gear ratio weighting factor defined in paragraph 3.1.3.1. of Annex 3.

The sound pressure level of the anchor point, L_{anchor} is defined as

$$L_{anchor} = L_{wot,annex 3} + X + (Limit_{Annex 3} - L_{urban,Annex 3})$$

where:

$L_{wot,Annex 3}$ is the reported value of the maximum sound pressure level of the acceleration test of Annex 3 as defined in paragraph 3.1.3.1. of Annex 3,

X is a general margin ($X = [3]$),

$Limit_{Annex\ 3}$ is the limit value of Annex 3 for the vehicle tested, and
 $L_{urban,Annex\ 3}$ is the final test result of Annex 3 for the vehicle tested as defined in paragraph 3.1.3.1. of Annex 3.

3.2. Not-to-exceed (NTE) point

For each gear k tested, the NTE point is defined in terms of vehicle speed and sound pressure level.

The vehicle speed of the NTE point for gear k , $v_{NTE,k}$, is defined as the maximum vehicle speed at BB' for ASEP tests according to the definition of the control range in paragraph 2.3. above.

The sound pressure level of the NTE point, L_{NTE} is defined as:

$L_{NTE} =$ Not To Exceed Level = Y =
 [81 dB(A) for M1 vehicles with PMR \leq 150 kW/t
 85 dB(A) for M1 vehicles with PMR \geq 150 kW/t
 82 dB(A) for M1 off road vehicles with GVW $>$ 2 tons
 82 dB(A) for N1 vehicles with GVW $<$ 2 tons
 83 dB(A) for N1 vehicles with 2 tons $<$ GVW $<$ 3,5 tons]

Or

[85 dB(A) for vehicles with PMR \geq 150 kW/t
 82 dB(A) for all other M1 and N1 vehicles]

3.3. Limit curve

The limit for a measurement in gear k is given as a function of vehicle speed v_k .

For vehicle speeds below the anchor point, the limit curve follows a fixed slope of $Z = [1]$ in units of dB/ 10 km/h:

$$Limit_{ASEP}(v_k) = L_{anchor} + Z * (v_k - v_{anchor})/10$$

For vehicle speeds above the anchor point, the limit curve is the linear connection between the anchor point and the NTE point:

$$Limit_{ASEP}(v_k) = L_{anchor} + (L_{NTE} - L_{anchor}) * (v_k - v_{anchor}) / (v_{NTE,k} - v_{anchor})$$

If the vehicle speed of the anchorpoint (v_{anchor}) exceeds the upper vehicle speed boundary of the ASEP control range (conform par 2.3), this latter part of the limit curve is obsolete.

Note: The value of the X, Y and Z coefficient are still in square brackets and may need additional discussion in GRB. They may also be tuned to the upcoming limits of the annex 3

4. COMPLIANCE TESTS

The Type Approval Authority may request tests to check the compliance of the vehicle with the requirements of this annex shall be carried out. To avoid undue work load, testing typically consists of 2 random test points in every valid gear. Pre-testing may be used to determine the most relevant test points. For all test points the control range as specified in paragraph 2.3. shall be met.

Appendix 1 to Annex 10

(Maximum format: A4 (210 x 297 mm))

Statement of compliance with the Additional Sound Emission Provisions

.....(Name of manufacturer) attests that vehicles of this type
.....(type with regard to its noise emission pursuant to ECE Regulation 51)
comply with the requirements of paragraph 6.2.3 of Regulation number 51
..... (Name of manufacturer) makes this statement in good faith, after
having performed an appropriate evaluation of the sound emission performance of the
vehicles.

Date:

Name of authorized representative

Signature of authorized representative:

B. JUSTIFICATION

Background

Traffic noise is a serious public health problem which is already recognized by the World Health Organization. The most cost-effective measures are those addressing the noise at the source. This was the background for the introduction of Regulation 51-03. In order to reduce effectively the noise by vehicles in a wider range of driving conditions the Additional Sound Emission Provisions (ASEP) were introduced.

In GRB 52 an ASEP proposal by the GRB chairman was discussed (ECE-TRANS-WP29-GRB-2010-09e). This system cannot be supported by the Netherlands as it distinguishes too little between noisy and silent vehicles. Many silent vehicles, with a maximum noise emission below 80 dB(A) have trouble to pass this proposal, while on the other hand vehicles with a maximum noise emission of more than 90 dB(A) will pass. Further information on this issue is given in documents ECE-TRANS-WP29-GRB-52-inf15e and ECE-TRANS-WP29-GRB-51-inf24e.

The Netherlands prefer a system which is simple, straight forward, limits the maximum noise emission, which is technology neutral and independent from the technology. Therefore the Netherlands put forward this updated ASEP proposal, which is based on a Not To Exceed Level, for consideration to GRB. We believe that this proposal has significant benefits over all earlier ASEP proposals.

Changes in this update

Two major changes have been incorporated:

1. implementations of the proposals for improvement from the TNO Venoliva report
2. transition to a fixed Not To Exceed Level in dB(A), instead of a delta relative to the Annex 3 limit.

In GRB 52 the TNO Venoliva report was presented (ECE-TRANS-WP29-GRB-52-inf07e). Besides a preference for the NL ASEP proposal, it contains several proposals to improve the NL ASEP proposal. The Netherlands has taken on board these proposals for improvement from the TNO report in this update.

1. Remove the 2 m/s² boundary in method B. This will improve the position of the ASEP anchor point while it has little effect on the method B result
2. Introduction of a slightly more lenient set of ASEP parameters XYZ:
 - a. Increase the Delta L from 8 to
 - i. Delta L = 12 for M1 vehicles with PMR > 150 kW/t
 - ii. Delta L_p = 9 for all other vehicles
 - b. Increase the Margin from 2 to 3, following the recommendation of TNO
This reduces the “collateral damage” (amount of uncritical vehicles that fail ASEP) to less than 1%.
3. Increase the 4 m/s² boundary from the ASEP control range to 5 m/s². This will enable testing of high-powered vehicles in 2nd gear as well, as many of these vehicles have an acceleration between 4 and 5 m/s².

4. Define the limit curve in terms of noise emission as function of vehicle speed, rather than as function of engine speed. This will enable testing a broader range of hybrid and electric vehicles.
5. Expand the ASEP regulation to partial throttle accelerations. This will ensure that all operating conditions of future vehicles will be subject to the ASEP regulation, which is essential for the effectiveness of the combination of type approval and ASEP regulations.

Another major change in this update of the NL ASEP proposal is: the NTE level is now given as an absolute noise level in dB(A) rather than a Delta on top of the Annex 3 type approval limit. The introduction of an absolute NTE Level follows the remarks in GRB of the UK and USA and may solve the criticism of industry that the NL ASEP proposal may become overly stringent if the Annex 3 limit is lowered. This NTE level is based on the following starting points:

1. The equivalent limits for annex 3 as determined in the TNO report page 34
2. The Delta Lp as given above

This leads to the following NTE levels:

- 81 dB(A) for M1 vehicles with $PMR \leq 150$ kW/t
- 85 dB(A) for M1 vehicles with $PMR \geq 150$ kW/t
- 82 dB(A) for M1 off road vehicles with $GVW > 2$ tons
- 82 dB(A) for N1 vehicles with $GVW < 2$ tons
- 83 dB(A) for N1 vehicles with $2 \text{ tons} < GVW < 3,5$ tons]

We could however agree on a simplification of this list e.g.

- 85 dB(A) for vehicles with $PMR \geq 150$ kW/t
- 82 dB(A) for all other M1 and N1 vehicles

Finally some text issues have been fine tuned

C. Clarification of changes in method 2 (NL) and differences to method 1 (OICA) as they appear in Annex 10

This chapter is based on document GRBIG ASEP 16-003 as the latest stage of the ASEP proposals

The changes to the text are highlighted in bold blue or ~~blue-strike-out~~.

Annex 10

MEASURING METHOD TO EVALUATE THE COMPLIANCE WITH THE
ADDITIONAL SOUND EMISSION PROVISIONS
only applicable for vehicles of categories M1 and N1
which are equipped with an internal combustion engine

1. INTRODUCTION

This annex describes a measuring method to evaluate the compliance of the vehicle with the additional sound emission provisions conform paragraph 6.2.3. of this regulation. The expected noise emission in a particular gear ratio is approximated by a linear function of engine speed. The anchor point of this linear function is based on the test results of annex 3.

1	2
The slope of this linear function is based on actual test results and limited to a maximum value.	No text

Although the vehicle shall meet the requirements in this annex, it is not obligatory to perform actual tests when applying for type approval. It is obligatory for the manufacturer to sign a declaration of compliance conform Appendix 1 to this annex. The type approval authority shall have the possibility to ask for additional information about the declaration of compliance and/or carry out the tests as described below.

The analysis of Annex 10 requires the performance of a test according to Annex 3. This Annex 3 test has to be performed under similar conditions on the same track as the tests according to Annex 10.

2. MEASURING METHOD

2.1 measuring instruments and condition of measurements

Unless specified differently here after, the measuring instruments, the conditions of the measurements and the condition of the vehicle are equal to those specified in Annex 3 paragraph 1 and 2.

If the vehicle has different modes that affect sound emission, all modes shall comply with the requirements in this annex. In the case the manufacturer has performed tests to prove to the approval authority compliance with the above requirements, the modes used during those tests shall be reported in the test report shown in appendix 2 to Annex 10.

2.2. Method of testing

Unless specified differently here after, the conditions and procedures of Annex 3 paragraph 3.1 until 3.1.2.1.2.2. shall be used.

Differing from Annex 3, single measurements are processed and evaluated.

2.3 Control range

There is a range of valid operation conditions which have to fall within the following boundary conditions:

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

Vehicle acceleration aWOT ASEP: $a_{WOT} \leq 4,0$ 5,0 m/s²

Engine speed n_{BB_ASEP} : $n_{BB} \leq 2,0 * \text{pmr}^{-0,222} * s$ or

$n_{BB} \leq 0,9 * s$ whichever is the lowest

Vehicle speed V_{BB_ASEP} :

if n_{BB_ASEP} is reached in one gear $v_{BB} \leq 70$ km/h

in all other cases $v_{BB} \leq 80$ km/h*

gears $k \leq$ highest gear measured in Annex 3

[k not first gear]

* If the vehicle, in the lowest valid gear, does not achieve the maximum engine speed below 70 km/h, the vehicle speed limit is 80 km/h

2.6 Gear ratios

The ASEP requirements apply to every gear ratio k that leads to test results within the control range as defined in paragraph 2.3 in this Annex.

In case of vehicles with automatic transmissions, adaptive transmissions and CVT's tested with non-locked gear ratios, the test may include a gear ratio change to a lower range and a higher acceleration. A gear change to a higher range and a lower acceleration is not allowed. A gear shifting which leads to a condition that is not in compliance with the boundary conditions shall be avoided. In that case, it is permitted to establish and use electronic or mechanical devices, including alternate gear selector positions.

1	2
<p>2.5 <u>Target conditions</u></p> <p>The sound emission shall be measured in each valid gear ratio at the four test points as specified below.</p> <p>The first test point P₁ is defined by using an entry speed v_{AA} of 20 km/h. If a stable acceleration condition cannot be achieved the speed shall be increased in steps of 5 km/h until a stable acceleration is reached.</p> <p>The fourth test point P₄ is defined by the maximum vehicle speed at BB' in that gear ratio within the boundary conditions according to paragraph 2.3</p> <p>The other two test points are defined by the following formula:</p> <p>Test Point P_j : $v_{BB_j} = v_{BB_1} + (j-1)/3 * (v_{BB_4} - v_{BB_1})$ for j = 2 and 3</p> <p>where v_{BB_1} = vehicle speed at BB' of test point P₁ v_{BB_4} = vehicle speed at BB' of test point P₄</p> <p>Tolerance for v_{BB_j}: +/- 3 km/h</p> <p>For all test points the boundary conditions as specified in 2.3 shall be met.</p>	<p>No text</p>

1	2
2.6. <u>Test of the vehicle</u>	2.5. <u>Test of the vehicle</u>

The path of the centerline of the vehicle shall follow line CC' as closely as possible throughout the entire test, from the approach to line AA' until the rear of the vehicle passes line BB'

1	2
<p>At line AA' the accelerator shall be fully depressed. To achieve a more stable acceleration or to avoid a down shift between line AA' and BB' pre-acceleration before line AA' may be used. The accelerator shall be kept in depressed condition until the rear of the vehicle reaches line BB'.</p>	<p>Before line AA' the accelerator shall be operated to a stable position, leading to a valid acceleration as defined in paragraph 2.3 above. The accelerator must not necessarily be fully depressed, as also partial throttle tests may be checked for compliance with the limit curve as defined in paragraph 3.3. The accelerator shall be kept in this stable position until the rear of the vehicle reaches line BB'</p>

For every separate test run the following parameters shall be determined and noted:

- The maximum A-weighted sound pressure level of the both sides of the vehicle indicated during each passage of the vehicle between the two lines AA' and BB', mathematically rounded to the first decimal place. ($L_{wot,kj}$). If a sound peak obviously out of character with the general sound pressure level is observed, the measurement shall be discarded. Left and right side may be measured simultaneously or separately.
- The vehicle speed readings at AA' and BB' shall be reported with the first significant digit after the decimal place. ($v_{AA,kj}$; $v_{BB,kj}$)
- If applicable, the engine speed readings at AA' and BB' shall be reported as a full integer value. ($n_{AA,kj}$; $n_{BB,kj}$)

The calculated acceleration shall be determined in accordance to the formulas in annex 3 par 3.1.2.1.2 and reported to the second digit after the decimal place ($a_{wot,test,kj}$).

1	2
No text	A test run is valid only if the measured vehicle performance and operation conditions fall inside the ASEP control range specified in paragraph 2.3. above

Note: Chapter 3 and 4 are totally different in proposal 1 and 2. Therefore they are reproduced below as integral chapters rather than paragraph by paragraph.

1
<p>3. ANALYSIS OF RESULTS</p> <p>3.1. <u>Determination of the anchor point for each gear ratio</u></p> <p>For measurements in gear i and lower, the anchor point consists of the maximum sound level L_{woti}, the reported engine speed n_{woti} and vehicle speed v_{woti} at BB' of gear ratio i of the acceleration test in Annex 3.</p> $L_{anchor,i} = L_{woti,annex\ 3}$ $n_{anchor,i} = n_{BB,woti,annex\ 3}$ $V_{anchor,i} = V_{BB,woti,annex\ 3}$ <p>For measurements in gear i+1 the anchor point consists of the maximum sound level L_{woti+1}, the reported engine speed n_{woti+1} and vehicle speed v_{woti+1} at BB' of gear ratio i+1 of the acceleration test in Annex 3.</p> $L_{anchor,i+1} = L_{woti+1,annex\ 3}$ $n_{anchor,i+1} = n_{BB,woti+1,annex\ 3}$ $V_{anchor,i+1} = V_{BB,woti+1,annex\ 3}$ <p>3.2. <u>Calculation of the slope of the regression line for each gear</u></p> <p>The sound measurements shall be evaluated as function of engine speed according to 3.2.1,</p>

3.2.1 Calculation of the regression line as function of engine speed

The linear regression line is calculated using the anchor point and the four correlated additional measurements.

$$\text{Slope}_k = \frac{\sum_{j=1}^5 (n_j - \bar{n})(L_j - \bar{L})}{\sum_{j=1}^5 (n_j - \bar{n})^2} \quad (\text{in dB/1000 rpm})$$

$$\text{With } \bar{L} = \frac{1}{5} \sum_{j=1}^5 L_j ;$$

$$\bar{n} = \frac{1}{5} \sum_{j=1}^5 n_j ;$$

where n_j = engine speed measured at line BB'

3.2.2 Slope for further calculation

The slope of a particular gear for the further calculation is the derived result of the calculation formula under 3.2.1 rounded to the first decimal place, but not higher than

[6] dB/1000 rpm

3.3 Calculation of the linear noise level increase expected for each measurement

The sound level $L_{\text{ASEP},kj}$ for measurement point j in gear k shall be calculated using the engine speeds measured for each measurement point, using the slope determined in 3.2 relative to the specific anchor point for each gear ratio.

$$L_{\text{ASEP},kj} = L_{\text{anchor},k} + (\text{Slope}_k - Y) * (n_{\text{BB},kj} - n_{\text{anchor},k})/1000 \quad \text{for } n_{\text{BB},kj} \leq n_{\text{anchor},k}$$

$$\text{and } L_{\text{ASEP},kj} = L_{\text{anchor},k} + (\text{Slope}_k + Y) * (n_{\text{BB},kj} - n_{\text{anchor},k})/1000 \quad \text{for } n_{\text{BB},kj} > n_{\text{anchor},k}$$

Where $Y = [1]$

3.4 Samples

On request of the type approval authority two additional runs within the boundary conditions according to paragraph 2.3 of the Annex shall be carried out.

4. INTERPRETATION OF RESULTS

Every individual noise measurement shall be evaluated.

The sound level of every specified measurement point shall not exceed the limits given below:

$$L_{kj} \leq L_{ASEP_kj} + [2 \text{ dB(A)}] + [(Limit_{Annex 3} - L_{urban,Annex 3})]$$

If the measured noise level in a point exceeds the limit, two additional measurements at the same point shall be carried out to verify the measurement uncertainty. The vehicle is still in compliance with ASEP, if the average of the three valid measurements at this specific point fulfills the above specification.

[5.

To avoid the possibility for vehicles to become significantly more noisy under the conditions regulated in the former ECE-R 51, a reference value L_{ref} shall be determined out of the calculated regression line as follows:

1. The determination of gear k with $k=3$ for manual transmission and lockable automatic transmission with up to 5 gears and $k=4$ for lockable automatic transmission with 6 or more gears. In the case of a non lockable automatic gear box the gear k shall be chosen by the ASEP-Testdiagram in the way, that V_{BB} is nearest to 61km/h.

2. Calculation of n_{ref_k} in accordance to vehicle speed V_{ref} at the respective gear ratio k with

$$V_{ref}=V_{BB}= 61 \text{ km/h}$$

3. Calculation of L_{ref} with

$$L_{ref} = L_{anchor_k} + Slope_k * (n_{ref_k} - n_{anchor_k}) / 1000$$

The Limit for L_{ref} shall be 76dB(A).

For vehicles fitted with a **manual** gear box having more than four forward gears and equipped with an engine developing a maximum power greater than 140 kW (ECE) and having a maximum-power/maximum-mass ratio greater than 75 kW/t, L_{ref} shall be increased by **3 dB(A)**.

For vehicles fitted with an **automatic** gear box having more than four forward gears and equipped with an engine developing a maximum power greater than 140 kW (ECE) and having a maximum-power/maximum-mass ratio greater than 75 kW/t, L_{ref} shall be increased by **2 dB(A)**.]

3. NOISE LIMITATION

The maximum A-weighted sound pressure level recorded during a test run as specified above shall not exceed the limit curve defined below.

3.1. Anchor point

The anchor point is defined in terms of **engine vehicle** speed and sound pressure level.

The **engine vehicle** speed of the anchor point, n_{anchor} v_{anchor} , is the effective **engine vehicle** speed at BB' of the acceleration test in Annex 3. In the case of a single gear test in gear i the **engine vehicle** speed of the anchor point is:

$$n_{\text{anchor}} = n_i \quad v_{\text{anchor}} = v_i$$

In the case of a two-gear test in gears i and $i+1$ the **engine vehicle** speed of the anchor point is the weighted average of the **engine vehicle** speeds in both gears, namely

$$n_{\text{anchor}} = n_{i+1} + k*(n_i - n_{i+1}), \quad v_{\text{anchor}} = v_{i+1} + k*(v_i - v_{i+1}),$$

where k is the gear ratio weighting factor defined in paragraph 3.1.3.1. of Annex 3.

The sound pressure level of the anchor point, L_{anchor} is defined as

$$L_{\text{anchor}} = L_{\text{wot,annex 3}} + X + (Limit_{\text{Annex 3}} - L_{\text{urban,Annex 3}})$$

where:

$L_{\text{wot,Annex 3}}$ is the reported value of the maximum sound pressure level of the acceleration test of Annex 3 as defined in paragraph 3.1.3.1. of Annex 3,

X is a general margin ($X = [3]$),

$Limit_{\text{Annex 3}}$ is the limit value of Annex 3 for the vehicle tested, and

$L_{\text{urban,Annex 3}}$ is the final test result of Annex 3 for the vehicle tested as defined in paragraph 3.1.3.1. of Annex 3.

3.2. Not-to-exceed (NTE) point

For each gear k tested, the NTE point is defined in terms of **engine vehicle** speed and sound pressure level.

The **engine vehicle** speed of the NTE point for gear k , $n_{\text{NTE,k}}$ $v_{\text{NTE,k}}$, is defined as the maximum **engine vehicle** speed at BB' for ASEP tests according to the definition of the control range in paragraph 2.3. above.

The sound pressure level of the NTE point, L_{NTE} is defined as:

~~$$L_{NTE} = \text{Limit}_{\text{Annex 3}} + Y$$~~

where:

~~Limit_{Annex 3} is the limit value of Annex 3 for the vehicle tested, and~~

~~Y is the allowed noise increase in the ASEP control range (Y = [8]).~~

[L_{NTE} = Not To Exceed Level = Y =

81 dB(A) for M1 vehicles with PMR ≤ 150 kW/t

85 dB(A) for M1 vehicles with PMR ≥ 150 kW/t

82 dB(A) for M1 off road vehicles with GVW > 2 tons

82 dB(A) for N1 vehicles with GVW < 2 tons

83 dB(A) for N1 vehicles with 2 tons < GVW < 3,5 tons]

Or

[85 dB(A) for vehicles with PMR ≥ 150 kW/t

82 dB(A) for all other M1 and N1 vehicles]

3.3. Limit curve

The limit for a measurement in gear k is given as a function of **engine vehicle** speed $n_k v_k$.

For **engine vehicle** speeds below the anchor point, the limit curve follows a fixed slope of $Z = [3] [1]$ in units of ~~dB/1000 min⁻¹~~: **dB/ 10 km/h:**

~~$$\text{Limit}_{\text{ASEP}}(n_k) = L_{\text{anchor}} + Z * (n_k - n_{\text{anchor}})/1000$$~~

~~$$\text{Limit}_{\text{ASEP}}(v_k) = L_{\text{anchor}} + Z * (v_k - v_{\text{anchor}})/10$$~~

For **engine vehicle** speeds above the anchor point, the limit curve is the linear connection between the anchor point and the NTE point:

~~$$\text{Limit}_{\text{ASEP}}(n_k) = L_{\text{anchor}} + (L_{\text{NTE}} - L_{\text{anchor}}) * (n_k - n_{\text{anchor}}) / (n_{\text{NTE},k} - n_{\text{anchor}})$$~~

~~$$\text{Limit}_{\text{ASEP}}(v_k) = L_{\text{anchor}} + (L_{\text{NTE}} - L_{\text{anchor}}) * (v_k - v_{\text{anchor}}) / (v_{\text{NTE},k} - v_{\text{anchor}})$$~~

If the vehicle speed of the anchorpoint (v_{anchor}) exceeds the upper vehicle speed boundary of the ASEP control range (conform par 2.3), this latter part of the limit curve is obsolete.

Note: The value of the X, Y and Z coefficient are still in square brackets and may need additional discussion in GRB. They may also be tuned to the upcoming limits of the annex 3

4. COMPLIANCE TESTS

The Type Approval Authority may request tests to check the compliance of the vehicle with the requirements of this annex shall be carried out. To avoid undue work load, testing typically consists of 2 random test points in every valid gear. Pre-testing may be used to determine the most relevant test points. For all test points the control range as specified in paragraph 2.3. shall be met.

