

**Draft proposal for changes to the text of
TRANS/WP.29/GRB/2005/2/Rev.2 (Regulation No. 51.03)
in order to incorporate the Additional Sound Emission Provisions
as changed during the meeting held on 28 and 29 January 2009**

Text in black is not changed compared to TRANS/WP.29/GRB/2005/2/Rev.2

~~Text crossed out has been removed~~

Text marked in green bold has been changed or added compared to TRANS/WP.29/GRB/2005/2/Rev.2 and has been agreed by the group

[Text in square brackets still **has to be discussed**]

Text in blue has not been agreed yet. Either it is proposed to be changed compared to the status of the last meeting and may need to be confirmed or it has been changed earlier and needs to be checked in more detail.

Text marked in orange bold has been added for clarification to remind the group and or GRB of earlier discussions or to highlight action points

Main body

6.2.3. Additional sound emission provisions

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

Note: OICA may wish to come forward with a definition of “bigger” N1 vehicles that might be excluded

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.

6.2.3.1. 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. These measures are commonly referred to as "cycle detection".

This shall not prevent the installation on a vehicle of any control device, function, system or measure if:

- **it is activated only for such purposes as engine protection, cold starting or warming up, or**
- **it is activated only for such purposes as operational security or safety and limp-home strategies.**

6.2.3.2. The vehicle shall meet the requirements of annex 10

~~{6.2.3.3. The sound emission of the vehicle under normal driving conditions different from the conditions of the type approval test in Annex 3 shall not differ considerably from what can be expected from the type approval test result for this specific vehicle with regard to technical practicability. This is fulfilled if the requirements of Annex 10 are met.}~~

6.2.3.3. In the application for type approval the manufacturer shall provide a statement (in conformity with Appendix xxx of annex 10) that the vehicle type to be approved complies with the requirements of paragraph 6.2.3 of this Regulation. [The type approval authority may require any relevant test to verify the compliance of the vehicle type to the additional sound emission provisions.]

(Note: In addition the 58 Agreement says:

”The approval authority may carry out any check or test prescribed... [] ... in the applicable Regulation (ECE R 51) annexed to this Agreement.”

For more clarity this sentence is incorporated into the regulation 51)

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. For COP purposes 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. **The type approval authority may carry out any check or test prescribed in this regulation to verify the compliance with the requirements of this regulation.**

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 (for M1 and N1 only).

At the request of the type approval authority, the vehicle(s) under test may be subjected to the test for Additional Sound Emission Provisions as 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 COP.

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.

~~3. Sampling~~

~~One vehicle has to be chosen. If after the test of paragraph 4.1. the vehicle is not considered to conform to the requirements of this Regulation, two more vehicles have to be tested.~~

~~4. Evaluation of the results~~

- ~~4.1. If the sound level of the vehicle tested pursuant to paragraphs 1. and 2. does not exceed by more than 1 dB(A) the limit value prescribed in~~
- ~~— paragraph 6.2.2. of this Regulation, for measurement according to paragraph 2.1. above, and in~~
 - ~~— paragraph 3. of Annex 6 to this Regulation, for measurement according to paragraph 2.2. above, and in~~
 - ~~— the vehicle type shall be considered to conform to the requirements of this Regulation.~~
- ~~4.2. If the vehicle tested according to paragraph 4.1. does not satisfy the requirements laid down in that paragraph, two more vehicles of the same type shall be tested pursuant to paragraphs 1. and 2.~~
- ~~4.3. If the sound level of the second and/or third vehicle of paragraph 4.2. exceeds by more than 1 dB(A) the limit values prescribed in paragraph 6.2.2. 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 a linear function of engine speed, with a correction for tyre noise. The anchor point of this linear function is based on the test results of annex 3 and on the gear ratio under test compared to the gear ratio in annex 3. The slope of this linear function is based on actual test results and limited to a maximum value. The individual noise measurements shall not exceed the expected noise emission by more than the allowed limit.

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 annex 1. The type approval authority shall have the possibility to ask for additional technical information in order to check the compliance of the vehicle with the requirements in paragraph 8 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.

Note: par 2 has been deleted, all paragraphs have to be renumbered. Par 5 has to be reworded in order to set requirements

3. MEASURING METHOD

3.1 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.

Note: In the following sub-paragraphs readings are assumed to be taken at line BB'. Currently it is still under discussion whether readings should be taken at PP', BB' or at Lmax. In the latter case more sophisticated (continuous) measuring equipment is necessary, both for annex 3 and annex 10 measurements as compared to the current annex 3 procedure. See list of decision to be made at the end of this document.

Some vehicles may have different software programs or modes which affect the acceleration behavior of the vehicle. Such programs may include, but are not limited to, the transmission (e.g. sporty, winter, adaptive, locked, unlocked, etc.), the electronic stability program (on/off) and the intelligent cruise control (on/off). If the vehicle has different modes leading

to valid accelerations, all these modes shall be in compliance with the requirements in this annex.

3.2. 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. have to be used.

3.3 Boundary conditions

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 speed V_{BB_ASEP} :	$[V_{BB} \leq 80 \text{ km/h}]$
Vehicle acceleration a_{WOT_ASEP} :	$[a_{WOT} \leq 5,0 \text{ m/s}^2]$
Engine speed n_{BB_ASEP} :	$[n_{BB} \leq 0.9 \cdot (s - n_{idle}) + n_{idle}]$

Note: (OICA) Proposals for boundary conditions have been made, but there was no detailed discussion on this topic up to now. As a general goal OICA aims for making the requirements as design neutral as possible.)

See list of decision to be made at the end of this document.

Some members want to skip the acceleration boundary completely. (in R41 there is no acceleration boundary)

The group will consider an OICA proposal to limit the gear ratio to $\leq i+1$

Under discussion is the max engine speed: either 90% or the formula by mr Steven.

3.4 Gear ratios

The ASEP requirements apply to every gear ratio k that leads to test results within the boundary conditions as defined in paragraph 3.3 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, to prevent a downshift to a gear ratio which leads to an acceleration higher than the boundary condition.

3.5 Target conditions

Four valid measurements shall be carried out in each valid gear ratio at the test points as specified below.

The first test point P_1 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.

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 3.3

The other two test points are defined by the following formula:

Test Point P_j : $v_{BB_j} = v_{BB_1} + (j-1)/3 * (v_{BB_{max}} - v_{BB_1})$ for j = 2 and 3

where v_{BB_1} = vehicle speed at BB' of test point P₁
 $v_{BB_{max}}$ = maximum vehicle speed in this gear ratio taking into account the boundary conditions in paragraph 3.3

Tolerance for v_{BB_j} : +/- 3 km/h

Note: Proposal from Germany to have point 2 and 3 randomly selected. And slope determined on point 1,4 and anchorpoint

For all test points the boundary conditions as specified in 3.3 shall be met.

3.6. 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'.

At the latest 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'.

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

- **The maximum A-weighted sound pressure level 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 results of each side shall be evaluated 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 ($a_{wot,test,kj}$).**

4. ANALYSIS OF RESULTS

4.1. Determination of the anchor point for each gear ratio

For measurements in gear ratio i 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.

$$L_{anchor,i} = L_{woti,annex\ 3}$$

$$n_{anchor,i} = n_{BB,woti, annex\ 3}$$

$$v_{anchor,i} = v_{BB,woti, annex\ 3}$$

For measurements in gear ratio $i+1$ 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.

$$L_{anchor,i+1} = L_{woti+1,annex\ 3}$$

$$n_{anchor,i+1} = n_{BB,woti+1, annex\ 3}$$

$$v_{anchor,i+1} = v_{BB,woti+1, annex\ 3}$$

For any gear ratio k different from gear ratio i or $i+1$, a tyre rolling sound correction is needed for the sound level $L_{anchor,k}$. For this correction the cruise by level L_{cruise} from annex 3 in gear i or $i+1$ shall be used, which ever is the lowest.

The sound level of the anchor point in gear k is calculated by:

$$L_{anchor,k} = 10 * \text{LOG}(10^{(L_{woti}/10)} - 10^{(L_{cruise}/10)} + 10^{((32*\text{LOG}(i_k/i_i)+L_{cruise})/10)})$$

where i_k = gear ratio of the tested gear k in kmh/1000rpm
 i_i = gear ratio of gear i in kmh/1000rpm

Note: OICA will provide a text for an optional compensation for pure tyre noise.

If the vehicle is evaluated as function of engine speed in gear ratios lower than gear i , the engine speed of the anchor point is:

$$n_{anchor,k} = n_{anchor,i} = n_{BB,woti, annex\ 3}$$

If the vehicle is evaluated as function of vehicle speed, in gear ratios lower than gear i , the vehicle speed of the anchor point is:

$$v_{anchor,k} = v_{anchor,i} = v_{BB,woti, annex\ 3}$$

Note: incomplete if gears higher than $i+1$ are not excluded

Note: for CVT's Japan has provided a different compensation for tyre noise. should be included in text

4.2 Calculation of the slope of the regression line for each gear

In principle the noise measurements have to be evaluated as function of engine speed according to 4.2.1, however if the four measurements according to 3.5 result in engine speeds that are within a range of $\pm 10\%$ of $n_{anchor,i}$, the noise measurements shall not be evaluated as function of engine speed, but as function of vehicle speed according to 4.2.2

Note: should be checked if CVT's have a meaningful slope as function of engine speed (ref paper Japan meeting 13) (decision to be made in meeting 15)

4.2.1 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.

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

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

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

where n_j = engine speed measured at line BB'

Note: will be changed according to proposal Germany. Adopted by the group Action Germany

4.2.2 Calculation of the regression line as function of vehicle speed

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

$$Slope_k = \frac{\sum_{j=1}^5 (n_j - \bar{n})(L_i - \bar{L})}{\sum_{j=1}^5 (n_j - \bar{n})^2} \quad (\text{in dB/10 kmh})$$

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

$$\bar{v} = \frac{1}{5} \sum_{j=1}^5 v_j ;$$

where v_j = vehicle speed measured at line BB'

Note: waiting for decision on 4.2.1

4.2.3 Slope for further calculation

The slope for the further calculation is the derived result of the calculation formulas under 4.2.1 or 4.2.2 rounded to the first decimal place, but not higher than the following borders:

For calculation as function of engine speed: [5] dB/1000 rpm

For calculation as function of vehicle speed: [3] dB/ 10 kmh

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

The expected sound level $L_{\text{expected},kj}$ for measurement point j in gear k shall be calculated using the engine speeds - respective vehicle speeds - measured for each measurement point, using the Slope determined in 4.2 relative to the specific anchor point for each gear ratio.

$$L_{\text{expected},kj} = L_{\text{anchor},k} + \text{Slope}_k * (n_{\text{BB},kj} - n_{\text{anchor},k})/1000, \text{ or}$$

$$L_{\text{expected},kj} = L_{\text{anchor},k} + \text{Slope}_k * (v_{\text{BB},kj} - v_{\text{anchor},k})/10$$

Note: could be changed if tyre noise compensation will be applied for every point separately.

5. INTERPRETATION OF RESULTS

Every individual noise measurement shall be evaluated.

The Requirements of Annex 10 are fulfilled if the difference between the measured sound level and the affiliated expected sound level for every measured point is lower than the limit.

$$L_{kj} - L_{\text{expeted},kj} \leq \text{Limit}_{\text{Annex 10}}$$

In which

$$\text{Limit}_{\text{Annex 10}} = [1] + (\text{Limit}_{\text{Annex 3}} - L_{\text{urban,Annex 3}})$$

Note: some members are proposing to set a variable margin dependent on the distance from the annex 3 operating conditions

Note: these values are meant to be rounded to the first decimal place

Note: It is unclear in annex 3 if the limit is an integer or not. Action: chairman address this to GRB.

If the measured noise level in a point exceeds the allowable margin, 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.

Note: It is helpful for test engineers to have a flow chart and a (Excel) calculation sheet. Action OICA

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 R51) 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:

Decisions to be made:

- 1. Is it sufficiently accurate to take (engine)speed measurements at BB' or is it necessary to take measurements at Lmax.**
- 2. Consequently: are continuous measuring devices necessary or not**
- 3. Boundary conditions**

Note: ad point 1 and 2 Mr Steven will provide next meeting an analysis.
