

**Draft proposal for changes to the text of
TRANS/WP.29/GRB/2005/2/Rev.2 (R51.03)
In order to incorporate the Additional Sound Emissions Provisions
Issued by the Netherlands
d.d. 11-5-2007**

Annex 1

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

COMMUNICATION

To Be Accomplished

[Measurement Results of annex 10?]

[Declaration of manufacturer for being in compliance with annex 10?]

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 compliance with the requirements of Annex 10 Additional Sound Emission Provisions has to be verified.
of

The vehicle(s) under test shall be subjected to the test for Additional Sound Emission Provisions as described in Annex 10. At least four measurements have to be carried out. The achieved engine speeds in these four measurements shall be randomly distributed between the highest engine speed as achieved in par 2.1 above and the engine speed boundary as given in Annex 10 par 3.3

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
- **paragraph 5 of Annex 10 to this Regulation, for measurements according to paragraph 2.3. above,**

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~~ **4.1 above**, 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

ADDITIONAL SOUND EMISSION PROVISIONS applicable for M1 and N1 only

~~During development of the provisions for off cycle emissions the technical provisions of UNECE Regulation No. 51.02 series of amendments shall be fulfilled.]~~

1. General

By applying for type approval the manufacturer automatically declares that the requirements of this Annex are fulfilled

~~The requirements of paragraph 6.2.3. are deemed to be fulfilled, if the vehicle manufacturer can show to the satisfaction of the technical service that the following requirement is fulfilled.~~

The technical service shall have the possibility to carry out practical tests and may ask for additional technical information in order to check the compliance of the vehicle with the requirements in this Annex.

Although practical test are not considered necessary in all cases. The technical service shall carry out such tests in at least 25% of the applications for compliance with this regulation.

2. Requirement

~~2.1. Documentation~~

~~The manufacturer shall provide a documentation that gives access to the design of the noise reduction system and the means by which it controls the noise output.~~

The noise emission of the vehicle shall not exceed the limit as given in paragraph 5 when it is measured in any of the possible operation conditions as given in paragraph 3

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.

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, 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 Target conditions and boundary conditions

There is not a single target condition for the measurements. There is a range of valid operation conditions which have to fall within the following boundary conditions:

Vehicle speed:	$20 \leq V_{BB} \leq 80 \text{ km/h}$
Vehicle acceleration:	$a_{wot} \leq 3.5 \text{ m/s}^2$
Engine speed:	$n_{BB} \leq 2.6 * PMR^{-0.29} * (s - n_{idle}) + n_{idle}$
and:	$n_{BB} \leq 0.9 * (s - n_{idle}) + n_{idle}$

3.4 Reference conditions:

Vehicle speed: $(V_{ref}) = 50 \text{ km/h}$

Engine speed: $(n_{ref}) = \text{the engine speed at line BB' in the lowest gear ratio } i \text{ as tested in Annex 3}$

3.5. Gear ratio selection

The selection of gear ratios for the test depends on their specific acceleration potential a_{wot} under full throttle condition. All gear ratios leading to a valid operation condition within the boundary condition as specified in 3.3. can be used for the test. Some vehicles may have different software programs or modes for the transmission. In that case the demands of paragraph 3.1 apply.

In case of automatic gear boxes (including adaptive transmissions and CVT's) the test may 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 leads to an acceleration higher than the boundary condition 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.

3.6. Acceleration test

Pre-acceleration before line AA' may be used to adjust the gear setting of automatic gear boxes and to achieve a more stable acceleration between line AA' and BB'. At the latest at line AA' the accelerator shall be fully depressed (as rapidly as is practicable). The accelerator shall be kept in this depressed condition until the rear of the vehicle reaches line BB'. The accelerator shall then be released as rapidly as possible.

The maximum A-weighted sound pressure level indicated during each passage of the vehicle between the two lines AA' and BB' (see Annex 8, Figure 1) shall be measured and noted, mathematically rounded to the first decimal place. 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 sequentially. The results of each side shall be evaluated separately.

For every separate noise measurement the following parameters should be determined and noted:

- The vehicle speed measurements at AA', BB', and PP' shall be noted and used in calculations to the first significant digit after the decimal place.
- The engine speed measurements at AA', BB', and PP' shall be noted and used in calculations to the first significant digit before the decimal place.
- The calculated acceleration $a_{wot\ test}$ shall be determined in accordance to the formulas in annex 3 par 3.1.2.1.2 and noted to the second digit after the decimal place.
- The position of the gear selector and (for vehicles with automatic gear boxes) the gear ratio at the moment of measuring the maximum noise.

At least eight valid measurements shall be carried out. At least four of them shall have an engine speed n_{BB} which is higher than the reference engine speed (n_{ref}) which is the highest engine speed as tested in Annex 3 (n_{BB} in gear i). The measurements shall be equally distributed over the range of valid operation conditions.

3.7. Coast by test

The maximum sound level expressed in A-weighted decibels (dB(A)) shall be measured to the first decimal place as the vehicle is coasting between lines AA' and BB' (see Annex 8, Figure 1- front end of the vehicle on line AA', rear end of the vehicle on line BB'). This value will constitute the result of the measurement.

At least two measurements shall be made on each side of the test vehicle at test speeds lower than the reference speed of 50 km/h. and at least two measurements at test speeds higher than the reference speed of 50 km/h. The speeds shall be approximately equally spaced over the speed range between 30 and 70 km/h.

For every noise measurement, the corresponding vehicle speed measurement at PP' shall be noted and used in calculations to the first significant digit after the decimal place.

4. Analysis and Interpretation of results

4.1 Data processing of coast by noise measurements

The individual coast by noise measurements shall be used to calculate the tyre rolling noise level L_{tyre} at the reference speed of 50 km/h, by means of a regression analysis according to:

$$L_{\text{tyre}} = \bar{L} - a \cdot \bar{v}$$

where:

\bar{L} is the mean value of the rolling noise levels L_i , measured in dB(A):

$$\bar{L} = \frac{1}{n} \sum_{i=1}^n L_i$$

n is the measurement number ($n \geq 8$),

\bar{v} is the mean value of logarithms of speeds V_i :

$$\bar{v} = \frac{1}{n} \sum_{i=1}^n v_i \quad \text{with} \quad v_i = \lg(V_i / V_{\text{ref}})$$

V_{ref} is the reference speed of 50 km/h

a is the slope of the regression line in dB(A):

$$a = \frac{\sum_{i=1}^n (v_i - \bar{v})(L_i - \bar{L})}{\sum_{i=1}^n (v_i - \bar{v})^2}$$

4.2 Data processing of accelerated noise measurements

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 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.

4.2.a. proposal Germany/France:

For the purpose of this regulation the following simplified noise model applies:

Note: The boundaries an exact solutions in 4.2.1 to 4.2.3 are still under discussion

**4.2.1 If $L_{wot,i} - L_{tyre}(v_{BB,i}) \geq [8]$ dB(A),
the expected vehicle noise is**

$$L_{vehicle,expected}(n) = L_{wot,i} + b \cdot (n - n_{ref})$$

$$b = 5 \text{ dB/1000 1/min for } n > n_{ref} \text{ and} \\ = 4 \text{ dB/1000 1/min for } n < n_{ref}$$

**4.2.2 If $[3] < L_{wot,i} - L_{tyre}(v_{BB,i}) < [8]$
The total expected vehicle noise is a function of engine speed (n) and vehicle speed (v)
and is an energetic sum of engine noise and tyre noise according to**

$$L_{vehicle,expected}(n,v) = 10 \cdot \log(10^{(L_{engine}(n)/10)} + 10^{(L_{tyre}(v)/10)})$$

Where

- $L_{tyre} = L_{tyre}(v_{ref}) + a \cdot \log(v/v_{ref})$, and
- $L_{engine} = L_{engine}(n_{ref}) + b \cdot (n - n_{ref})$

In which

- $v_{ref} = 50 \text{ km/h}$
- $L_{tyre}(v_{ref})$ and a have to be determined by coast by measurements according to the procedure in paragraph 3.7 and 4.1

and

- n_{ref} is equal to the engine speed at BB' as measured in annex 3 in gear i ($n_{BB',i}$)
- $b = 5 \text{ dB/1000 1/min for } n > n_{ref} \text{ and} \\ = 4 \text{ dB/1000 1/min for } n < n_{ref}$
- $L_{engine}(n_{ref}) = 10 \cdot \log(10^{(L_{wot,i}/10)} - 10^{(L_{tyre}(v_{BB',i})/10)})$
- $L_{wot,i}$ and $v_{BB',i}$ are taken from the measurement results in gear i in annex 3.

4.2.3 If $L_{wot,i} - L_{tyre}(v_{BB,i}) \leq 3$ dB(A),

the vehicle is excluded from further evaluation and is considered to be in compliance with the annex 10 demands.

4.2.4 Every individual noise measurement L_{wot} as derived from 3.6, together with its simultaneously measured engine speed and vehicle speed at line BB' ($n_{BB'}, v_{BB'}$), shall be compared to the expected vehicle noise $L_{vehicle,expected}(n_{BB'}, v_{BB'})$.

$$L_{\Delta} = L_{wot} - L_{vehicle,expected}$$

All results shall be noted in a table. The columns shall contain the test and analysis results (L_{Δ} , L_{wot} , $L_{vehicle,expected}$, $n_{BB'}$, $v_{BB'}$, gear ratio), the rows shall contain the sequential measurements (1,2,3...).

For easy evaluation, a graph may be used where the noise values are plotted as a function of engine speed. Measurements in different gear ratios shall be grouped together with specific colors or markings. In case of fixed gear ratios, lines shall be drawn for the $L_{vehicle,expected}(v)$ in every gear ratio separately. The measurement from annex 3 $L_{wot,i}$ shall be marked separately.

4.2.b. proposal Japan or Germany/France/Japan

Note In the discussions of the 6th meeting of the GRBIG ASEP a new proposal from Germany/France/Japan was mentioned. This would merge the proposal from Germany/France and the proposal from Japan. At this moment it is not clear if the above described proposal from Germany/France is already a merger with the original proposal from Japan or that another proposal from Germany/France/Japan is ment. Below the original proposal from Japan is described. If the newD/F/J proposal will be presented, it will be translated in to text here.

For the purpose of this regulation the following simplified noise model applies:

The total expected vehicle noise is a function of engine speed (n) according to

$$L_{vehicle,expected}(n) = L_{wot,i} + b^*(n - n_{BB',i,ref})$$

Where:

- $L_{wot,i}$, $n_{BB',i,ref}$ are the results of the acceleration tests in gear i in annex 3.
- n is the test result $n_{BB'}$ according to paragraph 3.6
- $b = 5 \text{ dB}/1000 \text{ 1/min}$ for $n > n_{BB',i,ref}$ and
 $= 4 \text{ dB}/1000 \text{ 1/min}$ for $n < n_{BB',i,ref}$

Every individual noise measurement L_{wot} as derived from 3.6, together with its simultaneously measured engine speed at line BB' ($n_{BB'}$), shall be compared to the expected vehicle noise $L_{vehicle,expected}(n_{BB'})$.

$$L_{\Delta} = L_{wot} - L_{vehicle,expected}$$

All results shall be noted in a table. The columns shall contain the test and analysis results (L_{Δ} , L_{wot} , $L_{vehicle,expected}$, $n_{BB'}$), the rows shall contain the sequential measurements (1,2,3...).

For easy evaluation, a graph may be used where the noise values are plotted as a function of engine speed. A line shall be drawn for the $L_{vehicle,expected}(n)$. The measurement from annex 3 ($L_{wot,i}$) shall be marked separately.

4.2.c. proposal based on presentation of OICA/mr Gerhard

Following the preceding discussions and the Excel data analysis sheet provided by mr Gerhard, OICA and/or mr Gerhard are evaluating a new concept wich is based on

the analysis of noise as function engine speed (in percentage of rated engine speed). After the clarification and discussions in the 7th meeting, this concept will be translated into text.

4.2.d. proposal based on presentation of the chairman

Before the 7th meeting a new concept was sent around. This concept was based on the assumption that vehicle noise is a function of vehicle speed and vehicle acceleration according to

$$L_{\text{vehicle,expected}}(v,a) = C_1 + C_2 * (a - a_{\text{ref}}) + C_3 * (v - v_{\text{ref}})$$

Depending on the clarification and discussions in the 7th meeting, this concept will be translated into text.

5. Noise limit

The difference between the measured noise level L_{wot} and the expected noise level $L_{\text{vehicle,expected}}$ shall not be more than 2.0 dB(A):

$$L_{\text{delta}} = L_{\text{wot}} - L_{\text{vehicle,expected}} \leq 2.0 \text{ dB}$$

This margin takes into account acceptable resonances and scatter of individual measurements.

Note: Some vehicles may have a non-linear noise behavior which makes them extra silent under conditions of annex 3, while being “like most of the others” under conditions of higher acceleration and/or engine speed. In order to allow this environmental advantage, it has been suggested to use in paragraph 4.2 as a reference noise level either $L_{\text{wot,i}}$ or the applicable noise limit from par 6.2.2 of this regulation, whichever is the highest.