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Item 3(b) of the provisional agenda

Regulation No. 51 (Noise of M and N categories of vehicles) – New limit values**Proposal for draft 03 series of amendments to Regulation No. 51 (Noise of M and N categories of vehicles)****Submitted by the expert from the International Organization of Motor Vehicle Manufacturers¹**

The text reproduced below was prepared by the expert from the International Organization of Motor Vehicle Manufacturers (OICA) in order to align the current stationary vehicle noise emission measurement provisions of the Regulation with those provided in the latest draft international standard ISO/DIS 362. The modifications to ECE/TRANS/WP.29/GRB/2012/8 are marked in bold for new or strikethrough the deleted characters.

¹ In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106 and ECE/TRANS/2010/8, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

I. Proposal

Insert new paragraphs 2.7.1. to 2.7.2., to read:

"2.7.1. Calculation of total engine power for hybrid vehicles

If two or more sources of propulsive power operate at the conditions of test specified in the regulation, the total engine power P_n , shall be the arithmetic sum of parallel propulsive engines on the vehicle. Applicable parallel propulsive engines are those power sources which provide forward motion to the vehicle in combination at the conditions of test specified in this regulation. Specified power for non-combustion engines shall be the power stated by the manufacturer.

2.7.2. Battery state of charge

If so equipped, propulsion batteries shall have a state-of-charge sufficiently high to enable all key functionalities per the manufacturer's specifications. Propulsion batteries shall be within their component-temperature window to enable all key functionalities. Any other type of rechargeable energy storage system shall be ready to operate during the test."

Paragraphs 2.11.1. to 2.11.2., amend to read:

2.11.1. Category M1, $M2 \leq 3,500$ kg, N1:

- (a) for front engine vehicles: front end of the vehicle;
- (b) for mid engine vehicles: centre of the vehicle;
- (c) for rear engine vehicles: rear end of the vehicle.

2.11.2. Category $M2 > 3,500$ kg, M3, N2, N3

~~The border of the engine closest to the front of the vehicle.~~

- (a) for front engine vehicles: it is the front end of the vehicle;**
- (b) for all other vehicles: it is the border of the engine closest to the front to the vehicle."**

Paragraph 5.2., amend to read:

"5.2. An approval number shall be assigned to each type approved. Its first two digits ~~(at present 02 corresponding to the 02 series of amendments which entered into force on 18 April 1995)~~ shall indicate"

Paragraphs 11.1. to 11.3, amend to read:

"11.1. As from the official date of entry into force of the ~~02~~ **03** series of amendments, no Contracting Party applying this Regulation shall refuse to grant **or refuse to accept type** approval under this Regulation as amended by the ~~02~~ **03** series of amendments.

11. 2. As from [1 October 1995], Contracting Parties applying this Regulation shall grant **type** approvals only if the vehicle type to be approved meets the requirements of this Regulation as amended by the ~~02~~ **03** series of amendments.

11. 3. **Contracting Parties applying this Regulation shall not refuse to grant extensions of type-approvals for existing types which have been issued according to the preceding series of amendments to this Regulation.**

~~As from 1 October 1996 Contracting Parties applying this Regulation may refuse first national registration (first entry into service) of a vehicle which does not meet the requirements of the 02 series of amendments to this Regulation."~~

Insert new paragraphs 11.4. to 11.5., to read:

"11.4. As from [1 October 1996], Contracting Parties applying this Regulation shall not be obliged to accept, for the purpose of national or regional type-approval, a vehicle type-approved to the preceding of amendments to this Regulation.

11.5. Notwithstanding the transitional provisions above, Contracting Parties whose application of this Regulation comes into force after the date of entry into force of the most recent series of amendments are not obliged to accept type-approvals which were granted in accordance with any of the preceding series of amendments to this Regulation / are only obliged to accept type approval granted in accordance with the 03 series of amendments."

Paragraph 11.4.(former), renumber as paragraph 11.6.

Annex3

Paragraph 2.2.1., amend to read:

"2.2.1. [The vehicle tested shall be selected in a way so that that all vehicles of the same type which are put on the market fulfill the requirements of this Regulation.]

The vehicle shall be representative of vehicles to be put on the market as specified by the manufacturer.

Measurements shall be made without any trailer, except in the case of non-separable vehicles. Measurements shall be made on vehicles at the test mass m_t specified according to the following table:

<i>Vehicle category</i>	<i>Vehicle test mass</i>
M ₁	$m_t = m_{ro}$
N ₁	$m_t = m_{ro}$
N ₂ , N ₃	<p>$m_t = 50$ kg per kW rated engine power</p> <p>Extra ...</p> <p>...</p> <p>The test mass for vehicles with more than two axles shall be the same as for a two-axle vehicle.</p> <p>If the unladen vehicle mass of a vehicle with more than two axles is greater than the test mass for the two-axle vehicle, then this vehicle shall be tested without extra loading.</p>
M ₂ , M ₃	$m_t = m_{ro} -$ mass of the crew member (if applicable)

"

Paragraph 2.2.2., amend to read:

"2.2.2. The tyres to be used for the test shall be representative for the **vehicle** and shall be selected by the vehicle manufacturer and recorded in Annex 9.
 ..."

Paragraph 3.1.2.1., amend to read:

"3.1.2.1. Vehicles of category M_1 , $M_2 \leq 3,500$ kg, N_1
 The path of ..
 ...
 The test speed v_{test} is 50 km/h ± 1 km/h. The test speed must be reached, when the reference point is at line PP'. **If the test speed is modified according to 3.1.2.1.4.1., the modified test speed shall be used for both the acceleration and constant speed test.**"

Paragraph 3.1.2.1.2., amend to read:

"3.1.2.1.2. Calculation of acceleration
 Acceleration calculations are applicable to M_1 , N_1 and $M_2 \leq 3500$ kg categories only.
 ... The speed at BB' is defined when the rear of the vehicle passes BB' ($v_{BB'}$) **or the front of the vehicle passes BB' +5m($v_{BB'}$)**. The method used for determination of the acceleration shall be indicated in the test report.
 Due to the definition of the reference point for the vehicle the length of the vehicle (l_{veh}) is considered differently in the formula below. If the reference point is in the front of the vehicle, then $l = l_{veh}$, mid: $l = \frac{1}{2} l_{veh}$ and rear: $l = 0$. **At the choice of vehicle manufacturer, front engine vehicles may use $l_{veh}=5m$, and mid engine vehicles may use $l_{veh}=2.5m$.**"

Paragraph 3.1.2.1.4., amend to read:

"3.1.2.1.4. Gear ratio selection
 ...
 Some vehicles ... closest to $a_{wot\ ref}$.
The vehicle transmission, gear, or gear ratio, shall be chosen to provide acceleration nearest to $a_{wot\ ref}$ according to 3.1.2.1.4.1. and 3.1.2.1.4.2.. The vehicle transmission, gear, or gear ratio may be controlled by electronic or mechanical measures including exclusion of kick-down function."

Paragraph 3.1.2.1.4.1., amend to read:

"3.1.2.1.4.1. Vehicle ... ratios
 ...
 (f) **If the next higher gear results in an acceleration below a_{urban} , the vehicle test speed v_{test} , shall be reduced by 2.5 km/h and the gear ratio selection shall proceed as specified by the options given in this paragraph. In no case shall the vehicle test speed be reduced below 40 km/h. In this case, a gear ratio is allowed even if $a_{wot\ test}$ does not exceed a_{urban} .**"

Paragraph 3.1.2.1.6., amend to read:

"3.1.2.1.6. Constant speed test

The constant speed test shall be carried out with the same gears specified for the acceleration test and a constant speed of 50 km/h with a tolerance of ± 1 km/h between AA' and BB'. **If the test speed is modified according to 3.1.2.1.4.1., the modified test speed shall be used.** During ...

The constant speed test is not required for vehicles with a PMR < 25 ."

Paragraphs 3.1.2.2. to 3.1.2.2.1.2., amend to read:

"3.1.2.2. Vehicles of categories $M_2 > 3,500$ kg, M_3 , N_2 , N_3

The path of the centreline 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' **and the reference point is 5 m behind line BB'**. The test shall ... The test mass of the vehicle shall be according to the table of paragraph 2.2.1.

Target conditions of category $M_2 > 3,500$ kg, N_2 :

~~When the reference point passes line BB', the engine speed $n_{BB'}$ shall be between 70 per cent and 74 per cent of speed S, at which the engine develops its rated maximum power, and the vehicle speed shall be 35 km/h \pm 5 km/h. Between line AA' and line BB' a stable acceleration condition shall be ensured.~~

When the reference point passes BB', the engine rotational speed $n_{BB'}$ shall fulfil the target engine rotational speed $n_{target BB'}$. The target engine rotational speed, $n_{target BB'}$ is defined as an interval from 70 per cent to 74 per cent of the speed S.

When the reference point passes BB', the vehicle speed $v_{BB'}$ shall fulfil the target vehicle speed $v_{target BB'}$. The target vehicle speed, $v_{target BB'}$ is defined as 35 km/h \pm 5 km/h.

Target conditions of Category M_3 , N_3 :

~~When the reference point passes line BB', the engine speed $n_{BB'}$ shall be between 85 per cent and 89 per cent of speed S, at which the engine develops its rated maximum power, and the vehicle speed shall be 35 km/h \pm 5 km/h. Between line AA' and line BB' a stable acceleration condition shall be ensured.~~

When the reference point passes BB', the engine rotational speed $n_{BB'}$ shall fulfil the target engine rotational speed $n_{target BB'}$. The target engine rotational speed, $n_{target BB'}$ is defined as an interval from 85 per cent to 89 per cent of the speed S.

When the reference point passes BB', the vehicle speed $v_{BB'}$ shall fulfil the target vehicle speed $v_{target BB'}$. The target vehicle speed, $v_{target BB'}$ is defined as 35 km/h \pm 5 km/h.

3.1.2.2.1. Gear ratio selection

~~3.1.2.2.1.1. Vehicles with manual transmissions~~

~~Stable acceleration condition shall be ensured. The gear choice is determined by the target conditions. If the difference in speed exceeds the given tolerance, then two gears should be tested, one above and one below the~~

target speed.

~~If more than one gear fulfils the target conditions select that gear which is closest to 35 km/h. If no gear fulfils the target condition for v_{test} two gears shall be tested, one above and one below v_{test} . The target engine speed shall be reached in any condition.~~

~~A stable acceleration condition shall be ensured. If a stable acceleration cannot be ensured in a gear, this gear has to be disregarded.~~

~~3.1.2.2.1.2. Vehicles with automatic transmissions, adaptive transmissions and transmissions with variable gear ratio (CVT's).~~

~~The gear selector position for full automatic operation shall be used. 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, at the specified test condition, shall be avoided. Therefore, it is permitted to establish and use electronic or mechanical devices to prevent a downshift to a gear ratio which is typically not used at the specified test condition in urban traffic.~~

~~If the vehicle includes a transmission design, which provides only a single gear selection (drive), which limits engine speed during the test, the vehicle shall be tested using only a target vehicle speed. If the vehicle uses an engine and transmission combination that does not fulfill paragraph 3.1.2.2.1.1., the vehicle shall be tested using only the target vehicle speed. The target vehicle speed for the test is $v_{\text{BB}} = 35 \text{ km/h} \pm 5 \text{ km/h}$. A gear change to a higher range and a lower acceleration is allowed after the reference point of the vehicle passes line PP'. Two tests must be performed, one with the end speed of $v_{\text{test}} = v_{\text{BB}} + 5 \text{ km/h}$, and one with the end speed of $v_{\text{test}} = v_{\text{BB}} - 5 \text{ km/h}$. The reported noise level is that result which is related to the test with the highest engine speed obtained during the test from AA' to BB'."~~

Insert new paragraphs 3.1.2.2.1.1. to 3.1.2.2.1.4., to read:

3.1.2.2.1.1. General

It is the responsibility of the manufacturer to determine the correct manner of testing to achieve the required conditions.

3.1.2.2.1.2. Manual transmission, automatic transmissions, adaptive transmissions or transmissions with continuously variable gear ratios (CVTs) tested with locked gear ratios

Stable acceleration condition shall be ensured. The gear choice is determined by the target conditions.

The following conditions for fulfilling the target conditions in 3.1.2.2 are possible.

- (a) **If one gear choice fulfils both target conditions for the rotational engine speed $n_{\text{target BB}}$ and for the vehicle speed $v_{\text{target BB}}$, test with that gear.**
- (b) **If more than one gear choice fulfils both target conditions for the rotational engine speed $n_{\text{target BB}}$ and for the vehicle speed $v_{\text{target BB}}$, test in gear i which gives vehicle speed $v_{\text{BB' gear } i}$ closest to 35 km/h.**
- (c) **If two gear choices fulfil both target conditions for the rotational engine speed $n_{\text{target BB}}$ and for the vehicle speed $v_{\text{target BB}}$ and fulfil the following condition:**

$$(v_{\text{target BB}'} - v_{\text{BB}' \text{ gear } i}) = (v_{\text{BB}' \text{ gear } i+1} - v_{\text{target BB}'}),$$

then both gears are taken for further calculation of L_{urban} .

- (d) If one gear choice fulfils the target condition for the rotational engine speed $n_{\text{target BB}'}$ but not the target condition for the vehicle speed $v_{\text{target BB}'}$, use two gears, gear_x and gear_y . The target conditions for the vehicle speed for these two gears are the following:

gear_x

$$25 \text{ km/h} \leq v_{\text{BB}'x} \leq 30 \text{ km/h}$$

and

gear_y

$$40 \text{ km/h} \leq v_{\text{BB}'y} \leq 45 \text{ km/h}$$

$$v_{\text{BB}'2} \geq v_{\text{target BB}'} + 5 \text{ km/h}.$$

Both gears, gear_x and gear_y shall fulfil the target rotational engine speed $n_{\text{target BB}'}$.

Both gears shall be used for further calculation of L_{urban} .

If only one of the gears fulfils the target rotational engine speed $n_{\text{target BB}'}$, test with that gear. This gear shall be used for further calculation of L_{urban} .

- (e) If none of the two gears fulfils the target rotational engine speed $n_{\text{target BB}'}$ under condition d), condition f) shall be chosen.
- (f) If no gear choice fulfils the target rotational engine speed, choose the gear which fulfils the target vehicle speed $v_{\text{target BB}'}$ and is closest to the target rotational engine speed $n_{\text{target BB}'}$, but not higher than $n_{\text{target BB}'}$.

$$v_{\text{BB}' \text{ gear } i} = v_{\text{target BB}'}$$

and

$$n_{\text{BB}' \text{ gear } i} \leq n_{\text{target BB}'}$$

A stable acceleration condition shall be ensured for all the above mentioned tests. If a stable acceleration cannot be ensured in a gear, this gear has to be disregarded.

3.1.2.2.1.3. Automatic transmission, adaptive transmissions and transmissions with variable gear ratio tested with non-locked gear ratios

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

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. In any case a gear change to a gear ratio which is typically not used at the specified condition as defined by the manufacturer in urban traffic shall be avoided.

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

The following conditions for fulfilling the target conditions in 3.1.2.2 are possible:

- (a) If the choice of the gear selector position fulfils both target conditions for the rotational engine speed $n_{\text{target BB}'}$ and for the vehicle speed $v_{\text{target BB}'}$, test with the gear selector in that position.
- (b) If the choice of the gear selector position fulfils the target condition for the rotational engine speed $n_{\text{target BB}'}$ but not the target condition for the vehicle speed $v_{\text{target BB}'}$, change the target condition for the vehicle speed to two vehicle target speeds as follows:

$v_{\text{BB}'1}$ is defined as

$$25 \text{ km/h} \leq v_{\text{BB}'1} \leq 35 \text{ km/h}$$

and

$v_{\text{BB}'2}$ is defined as

$$35 \text{ km/h} \leq v_{\text{BB}'2} \leq 45 \text{ km/h.}$$

Conduct two tests, one with $v_{\text{BB}'1}$ and one with $v_{\text{BB}'2}$.

Both test conditions are used for further calculation of L_{urban} .

- (c) If under condition b) the target rotational engine speed $n_{\text{target BB}'}$ cannot be fulfilled, condition d) shall be chosen.
- (d) If the choice of the gear selector position cannot fulfil the target condition for the rotational engine speed $n_{\text{target BB}'}$ but the target condition for the vehicle speed $v_{\text{target BB}'}$, change the target condition for the vehicle speed to two vehicle target speeds as follows:

$v_{\text{BB}'1}$ is defined as

$$25 \text{ km/h} \leq v_{\text{BB}'1} \leq 30 \text{ km/h}$$

and

$v_{\text{BB}'2}$ is defined as

$$40 \text{ km/h} \leq v_{\text{BB}'2} \leq 45 \text{ km/h.}$$

Conduct two tests, one with $v_{\text{BB}'1}$ and one with $v_{\text{BB}'2}$.

Use the test where $n_{\text{BB}'}$ is closest to the target rotational engine speed $n_{\text{target BB}'}$ but not higher than $n_{\text{target BB}'}$.

$$n_{\text{BB}' i} \leq n_{\text{target BB}'} \text{ for } i = 1, 2$$

If the vehicle cannot fulfil the condition

$$n_{\text{BB}' i} \leq n_{\text{target BB}'} \text{ for } i = 1, 2$$

condition (e) shall be used.

- (e) If the choice of the gear selector position cannot fulfil the target conditions for the rotational engine speed $n_{\text{target BB}'}$ and the target condition for the vehicle speed $v_{\text{target BB}'}$, change the target condition for the vehicle speed to

$$v_{\text{BB}'} = v_{\text{target BB}'} + 5 \text{ km/h}$$

Conduct the test with that vehicle speed $v_{BB'}$, where $n_{BB'}$ is closest to the target rotational engine speed $n_{\text{target } BB'}$.

A gear change to a higher range and a lower acceleration is allowed after the vehicle passes line PP'.

- (f) If the vehicle includes a transmission design, which provides only a single gear selection (D) that limits engine speed during the test, the vehicle shall be tested using only the target vehicle speed $v_{\text{target } BB'}$.

3.1.2.2.1.4. Powertrains with no rotational engine speed available

Vehicles with a powertrain where no rotational engine speed is available shall only fulfill the target condition for the vehicle speed $v_{\text{target } BB'}$.

The following conditions for fulfilling the target condition $v_{\text{target } BB'}$ in 3.1.2.2 are possible:

- (a) If no rotational engine speed is available only the target vehicle speed $v_{\text{target } BB'}$ has to be fulfilled.
- (b) If no rotational engine speed is available and the target vehicle speed $v_{\text{target } BB'}$ cannot be fulfilled two test conditions shall be conducted as follows:

$v_{BB'1}$ for the first test condition is defined as

$$25 \text{ km/h} \leq v_{BB'1} \leq 35 \text{ km/h}$$

and

$v_{BB'2}$ for the second test condition is defined as

$$35 \text{ km/h} \leq v_{BB'2} \leq 45 \text{ km/h.}$$

Both test conditions are used for further calculation of L_{urban} .

- (c) If no rotational engine speed is available and the target vehicle speed

$v_{\text{target } BB'}$ and

$v_{BB'1}$ defined as

$$25 \text{ km/h} \leq v_{BB'1} \leq 35 \text{ km/h}$$

cannot be fulfilled, only one test shall be conducted with $v_{BB'2}$

$v_{BB'2}$ is defined as

$$35 \text{ km/h} \leq v_{BB'2} \leq 45 \text{ km/h.}$$

The test condition for $v_{BB'2}$ is used for further calculation of L_{urban} .

Paragraph 3.1.3., amend to read:

"3.1.3. Interpretation of results

The maximum A-weighted sound pressure level indicated during each passage of the vehicle between the two lines AA' and BB' shall be noted, **to the first significant digit after the decimal place**. If a noise peak obviously out of character with the general sound pressure level is observed, the measurement shall be discarded. At least ...the final result.

The results of each side shall be averaged separately. The intermediate results for each side shall be the average mathematically rounded to the first decimal place. **All further calculations to derive L_{urban} shall be done separately for the left and right vehicle side. The final value to be reported as the test result shall be the higher value of the two sides.**

The speed measurements at AA' ($v_{AA'}$), BB' ($v_{BB'}$), and PP' ($v_{PP'}$) shall be noted and used in calculations to the first significant digit after the decimal place.

The calculated acceleration $a_{wot\ test}$ shall be noted to the second digit after the decimal place."

Paragraph 3.1.3.2., amend to read:

"3.1.3.2. Vehicles of categories $M_2 > 3,500\text{ kg}$, M_3 , N_2 , N_3

When one test condition is tested, the final result, L_{urban} , is the maximum value as specified in 3.1.3.

When the results of two test conditions are used, the arithmetic mean of the two averages for each side of these two conditions shall be calculated. The final result, L_{urban} , is the maximum value of the two calculated averages.

When one gear is ... calculated."

II. Justification

1. Paragraph 11. was amended according to the Guidelines on the scope, administrative provisions and alternative requirements in the Regulations annexed to the 1958 Agreement which includes the guidelines for transitional provisions (ECE/TRANS/WP.29/1044/Rev.1).

2. The other paragraphs are based on revised standard ISO/DIS 362 which is revised to clarify test protocol. Notably, para. 3.1.2.2.1.2 in this proposal is based on para. 8.3.2.3.2. of ISO/DIS 362-1.
