Submitted by the experts from OICA

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Proposal for a supplement 10 to the 03 series of amendments to UN Regulation No. 51

Some corrections and clarifications concerning power definition, calibration, temperature correction and Reference sound assessment have been included based on experiences with the last changes of this Regulation. The proposed changes are based on the 03 series of amendments to UN Regulation No. 51 up to Supplement 09. The modifications are marked in bold for new or strikethrough for deleted characters.

I.   Proposal

Paragraph 2.8., amend to read:

"2.8.   "Maximum net power, P_n" means the **declared** engine power available for propulsion expressed in kW and measured dependent on the drive train concepts **pursuant to UN Regulation No. 85 or GTR 21.**
Applicable power sources are those, which provide drive power for forward motion to the vehicle."

"2.8.   Maximum net power, Pn" means
-    the engine power available for propulsion expressed in kW ~~and measured dependent on the drive train concepts~~ **pursuant to GTR 21 for hybrid electric vehicles, or pure electric vehicles that have more than one propulsion energy converter.**
-    **the declared engine power available for propulsion expressed in kW pursuant to UN Regulation No. 85**.
Applicable power sources are those, which provide drive power for forward motion to the vehicle."

Paragraph 11.6., amend to read:

"11.6.   "Until 30 June ~~2025~~**2028**, vehicles with a serial hybrid drive train which have a combustion engine with no mechanical coupling to the power train are excluded from the requirements of paragraph 6.2.3. above. "

Add new paragraph 11.16., to read:

"**11.16.   Supplement 9 does not apply to existing type approvals and their extensions, granted prior to the date of entry into force of Supplement 9.**"

Annex 1 – Appendix 2
Paragraph 3.3. and its subparagraphs, amend to read:

"3.3.   Electric motor **(describe each type of electric motor separately)**

3.3.1.   **Make:** ....

3.3.2.   Type ~~(winding, excitation)~~: ....

3.3.**3.**~~1.1.~~   ~~Maximum hourly output~~ **Rated maximum net power**:   …. kW

3.3.**4.**~~1.2.~~   Operating voltage: …. V"

Annex 3, paragraph 2.2.3.4.2., amend to read:

"2.2.3.4.2.   Tyre conditioning

Tyres with special fitment requirements, such as asymmetric or directional design, shall also be mounted in accordance with these requirements.

Before testing, tyres shall be conditioned (broken-in). Tyre break-in shall be representative to about 100 km of normal on-road operation. Tyres with special fitment requirements shall be broken-in in accordance with these requirements. The tyres fitted to the test vehicle shall rotate in the same direction as when they were broken-in.

Test tyres shall be warmed-up immediately prior to testing for at least 10min in the range of the test speed, with moderate lateral & longitudinal acceleration. The lateral acceleration shall be selected in a way to avoid excessive tire tread wear effects. **If test tyres have operational temperature limits that do not cover the full temperature range of this regulation, the tyres shall be conditioned to their operational temperature regarding the provisions described in paragraph 2.2.3.1."**

Annex 3, paragraph 3.1.3.4.1.2., amend to read:

"3.1.3.4.1.2.   …

The final result is calculated by combining $L_{acc\ rep}$ and $L_{crs\ rep}$. The equation is:

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

The ~~weighting~~ **partial power** factor k_P **is given** ~~gives the part power factor~~ for urban driving. In cases other than a single gear test, k_P is calculated by:

$k_P = 1 - (a_{urban} / a_{wot\ ref})$

If only one gear was specified for the test, k_P is given by:

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

In cases where $a_{wot\ test}$ is less than a_{urban}:

$k_P = 0$ …"

Annex 3 - Appendix 2, Paragraph 3.2.4., amend to read:

"3.2.4.   For each gear, run and vehicle side under constant speed extract the power train component $L_{PT,crs,j}$ from the test result $L_{crs,j}$, by calculation.
$$L_{PT,crs,j} = 10 \times \lg\left(10^{0.1 \times L_{crs,j}} - 10^{0.1 \times L_{TR,crs,j,\vartheta_{crs}}}\right)$$

In case that $L_{TR,crs,\vartheta_{crs}}$ is greater than $L_{crs,j}$ the power train component $L_{PT,crs,j}$ is determined by

$$L_{PT,crs,j} = 10 \times \lg\left(0.01 \times 10^{0.1 \times L_{crs,j}}\right)$$

with $L_{TR,crs,j,\vartheta_{crs}}$ redefined as

$$\mathbf{L_{TR,crs,j,\vartheta_{crs}} = 10 \times \lg(0.99 \times 10^{0.1 \times L_{crs,j}})}$$

The redefined $L_{TR,crs,j,\vartheta_{crs}}$ shall then be subjected to temperature correction in 3.2.3 to obtain the corresponding $L_{TR,crs,j,\vartheta_{ref}}$."

Annex 3 - Appendix 2,
Paragraph 3.3.4., amend to read:

"3.3.4.   For each gear, run and vehicle side extract the power train component $L_{PT,wot,j}$ from the reported acceleration test $L_{wot,j}$, by calculation.

$$L_{PT,wot,j} = 10 \times lg\left(10^{0.1 \times L_{wot,j}} - 10^{0.1 \times L_{TR,wot,j,\vartheta_{wot}}}\right)$$

In case that ~~$L_{TR,wot,j,\vartheta_{wot}}$ is greater than $L_{wot,j}$~~

$$10^{0.1 \times L_{TR,wot,j,\vartheta_{wot}}} \geq 0.99 \times 10^{0.1 \times L_{wot,j}}$$

~~(a)~~ the power train component $L_{PT,wot,j}$ is determined by

$$L_{PT,wot,j} = 10 \times lg\left(0.01 \times 10^{0.1 \times L_{wot,j}}\right)$$

~~(b)   the tyre component $L_{TR,wot,j,\vartheta\_ref}$ is determined by~~

~~$L_{TR,wot,j,\vartheta_{ref}} = L_{TR,\vartheta_{ref},v_{TR\_ref}}$~~

with $L_{TR,wot,j,\vartheta_{wot}}$ **redefined as**

$$L_{TR,wot,j,\vartheta_{wot}} = 10 \times lg(0.99 \times 10^{0.1 \times L_{wot,j}})$$

The redefined $L_{TR,wot,j,\vartheta_{wot}}$ shall then be subjected to temperature correction in 3.2.3 to obtain the corresponding $L_{TR,wot,j,\vartheta_{ref}}$."

Annex 7, Paragraph 5.2., amend to read:

"5.2.   The determination of gear α is as follows:

- α = 3 for manual transmission and for automatic transmission tested in locked position with up to 5 gears;
- α = 4 for manual transmission and for automatic transmission tested in locked position with 6 or more gears. If the acceleration calculated from AA to BB + vehicle length in gear 4 exceeds 1.9 m/s², the first higher gear α > 4 with an acceleration lower than or equal to 1.9 m/s² shall be chosen. **If there is no gear with an acceleration less than or equal to 1.9 m/s² available, the highest available gear shall be chosen.**

For vehicles tested under locked condition, the gear ratio for further calculation shall be determined from the acceleration test result in Annex 3.

For vehicles tested under non-locked condition, the gear ratio for further calculation shall be determined from the acceleration test result in Annex 3 using the reported engine speed and vehicle speed at line BB'."

II. Justification

1. *Paragraph 2.8. "Maximum net power, P_n "*

By using the declared value, the requirements regarding tolerances and measurement uncertainties described in UN Regulation No. 85 will be applied.

2. *Paragraph 11.6 "TPs for serial hybrids"*

Paragraph 11.6. has been amended to postpone the application date for vehicles with a serial hybrid drive train which have a combustion engine with no mechanical coupling to the power train by 3 additional years.

Vehicles with a serial hybrid drive train which have a combustion engine with no mechanical coupling to the power train are excluded from the requirements of paragraph 6.2.3. because current ASEP in Annex 7 cannot be applied to those vehicles due to no valid data according to the test procedure in Annex 7.

RD-ASEP in Annex 9 has been improved to apply all type of vehicles including serial hybrid. Since Annex 7 shall continue to be conducted before RD ASEP will be replaced with Annex 7, therefore extension of traditional provisions are needed until expected date of RD-ASEP introduction.

3. *Paragraph 11.16 "TPs Supplement 9"*

The transitional provisions of Supplement 9 are missing. Supplement 9 itself only adds the description related to monitoring in RD-ASEP (Annex 9), however, because it is considered to include the content up to Suppl.8 as well, transitional provisions are needed.

4. *Annex 1, Appendix 2, paragraph 3.3. Electric motor*

The "technical information document" has been aligned to the power definitions of UN Regulation No. 85, this regulation is referring to in paragraph 2.8.

5. *Annex 3, paragraph 2.2.3.4.2. Tyre conditioning*

Track tyres that can also be used on public roads shall only be used at operational temperature conditions they are designed for. These tyres should be exempted from measurements at low air temperatures since this not their use case regarding temperature.

6. *Annex 3, paragraph 3.1.3.4.1.2. Partial power factor*

k_p is defined as partial power factor, the term weighting factor is not correct.

7. *Annex 3, Appendix 2, paragraphs 3.2.4. and 3.3.4., Extraction of the power train component*

Regarding the temperature correction according to Annex 3 – Appendix 2, a conflict will occur in case that the determined tyre rolling sound by tests according to Annex 3 - Appendix 3 is greater than the Annex 3 test result (either constant speed or accelerated). If only the power train sound $L_{PT,crs,j}$ or $L_{PT,wot,j}$ is buffered, this will lead to an increase of the original measurement result, independent from any temperature correction. This effect can occur by measurement uncertainty of the tyre rolling sound measurement itself. It is proposed to split in this case the test run result by 1% powertrain energy (as is already implemented in the regulation) and 99% tyre rolling sound.

8. *Annex 7, paragraph 5.2, Reference sound assessment*

The reference sound assessment is based on the 02 series of amendments of this regulation. At this time the 4th gear was the highest possible gear for testing vehicles in urban condition.

Nowadays some vehicles can accelerate even in higher gears with more than 1.9 m/s². These changes reflect this development and clarifies some undefined cases.