

Consolidated version of Supplement 8 to the 03 series of amendments to UN Regulation No. 51

The text reproduced below has been prepared by the experts of the Informal Working Group on Measurement Uncertainties (IWG MU), the experts of the Informal Working Group on Additional Sound Emission Provisions (ASEP) and by the experts from the International Organization for Standardization (ISO). In this text, documents GRBP/2022/13, GRBP/2022/16 and GRBP-76-09 all presented and adopted at the 76th session of GRBP have been consolidated. The documents have been prepared to utilize the latest ISO 10844 standard test surface and also to improve measures to reduce variability in the Regulation.

In addition to that some corrections to the 03 Series of amendments to UN Regulation No.51 (see working document GRBP/2023/12) have been added by the experts of the Informal Working Group on Measurement Uncertainties, Informal Working Group on ASEP and ISO. The proposed changes are based on the 03 series of amendment to UN Regulation No. 51 up to Supplement 7. The modifications are marked in bold for new or strikethrough for deleted characters and the corrections are highlighted in green.

I. Proposal

Paragraph 2.24., amend to read:

“2.24 Table of symbols

...
$L_{ers i}$	dB(A)	Annex 3	3.1.3.4.1.2	vehicle sound pressure level at constant speed test for gear i ; value to be reported and used for calculations to the first decimal place
$L_{ers (i + 1)}$	dB(A)	Annex 3	3.1.3.4.1.2	vehicle sound pressure level at constant speed test for gear $(i + 1)$; value to be reported and used for calculations to the first decimal place
$L_{ers rep}$	dB(A)	Annex 3	3.1.3.4.1.2	reported vehicle sound pressure level at constant speed test; value to be reported and used for calculations to the first decimal place
$L_{wot i}$	dB(A)	Annex 3	3.1.3.4.1.2	vehicle sound pressure level at wide-open-throttle test for gear i ; value to be reported and used for calculations to the first decimal place
$L_{wot (i + 1)}$	dB(A)	Annex 3	3.1.3.4.1.2	vehicle sound pressure level at wide-open-throttle test for gear $(i + 1)$; value to be reported and used for calculations to the first decimal place
$L_{wot rep}$	dB(A)	Annex 3	3.1.3.4.1.2	reported vehicle sound pressure level at wide-open-throttle; value to be reported and used for calculations to the first decimal place
L_{urban}	dB(A)	Annex 3	3.1.3.4.1.2	reported vehicle sound pressure level representing urban operation; value to be reported mathematically rounded to the nearest integer
...

Paragraph 11, add new subparagraphs 11.13. and 11.14., to read:

11.14. Supplement 8 does not apply to existing type approvals, originally granted prior to the date of entry into force of Supplement 7.

11.15. From the entry into force of Supplement 8, ISO 10844:2021 shall be accepted for all approvals granted under this Regulation. Until five years from the entry into force of Supplement 8, ISO 10844:2014 shall be accepted for all approvals granted under this Regulation.”

Annex 3, paragraph 2.1.1., amend to read:

“2.1.1. Test Site Outdoor

The surface of the test track and the dimensions of the test site shall be in accordance with ISO 10844:2014~~2014~~2021.”

Annex 3, Paragraph 3.1.2.1.1., amend to read:

“3.1.2.1.1. Power to mass ratio index (PMR)

PMR is defined as follows:

$PMR = (P_n / m_{ro}) * 1000 \text{ kg/kW}$, where P_n is measured in kW **and defined according to paragraph 2.8. of the main body** and m_{ro} is measured in kg and defined according to paragraph 2.4. of the main body.

~~If two or more sources of propulsive power operate at the conditions of test specified in paragraph 3.1.2.1 of Annex 3 to this Regulation, the total engine net 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 paragraph 3.1.2.1. of Annex 3 to this Regulation. Specified power for non-combustion engines shall be the power stated by the manufacturer.~~

The PMR with no dimension is used for the calculation of acceleration.”

Annex 3, Paragraph 3.1.2.1.3., amend to read:

3.1.2.1.3. Partial power factor k_p

The partial power factor k_p (see paragraph 3.1.3.4.1.2) is used for the weighted combination of the test results of the acceleration test and the constant speed test for vehicles of category M_1 and N_1 and $M_2 \leq 3,500 \text{ kg}$ technically permissible maximum laden mass

In cases other than a single gear test, $a_{wot \text{ ref}}$ shall be used instead of $a_{wot \text{ test}}$ (see paragraph 3.1.3.4.1.2).

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 $L_{wot \text{ rep}}$ and $L_{crs \text{ rep}}$. The equation is:

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

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

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

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

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

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

$$k_p = 0$$

In cases where the PMR of the vehicle is lower than 25 the final result L_{urban} is the result of the acceleration test:

$$L_{urban} = L_{wot \text{ rep}}$$

In cases where $L_{wot,rep}$ is less than $L_{crs,rep}$:

$$k_p=1$$

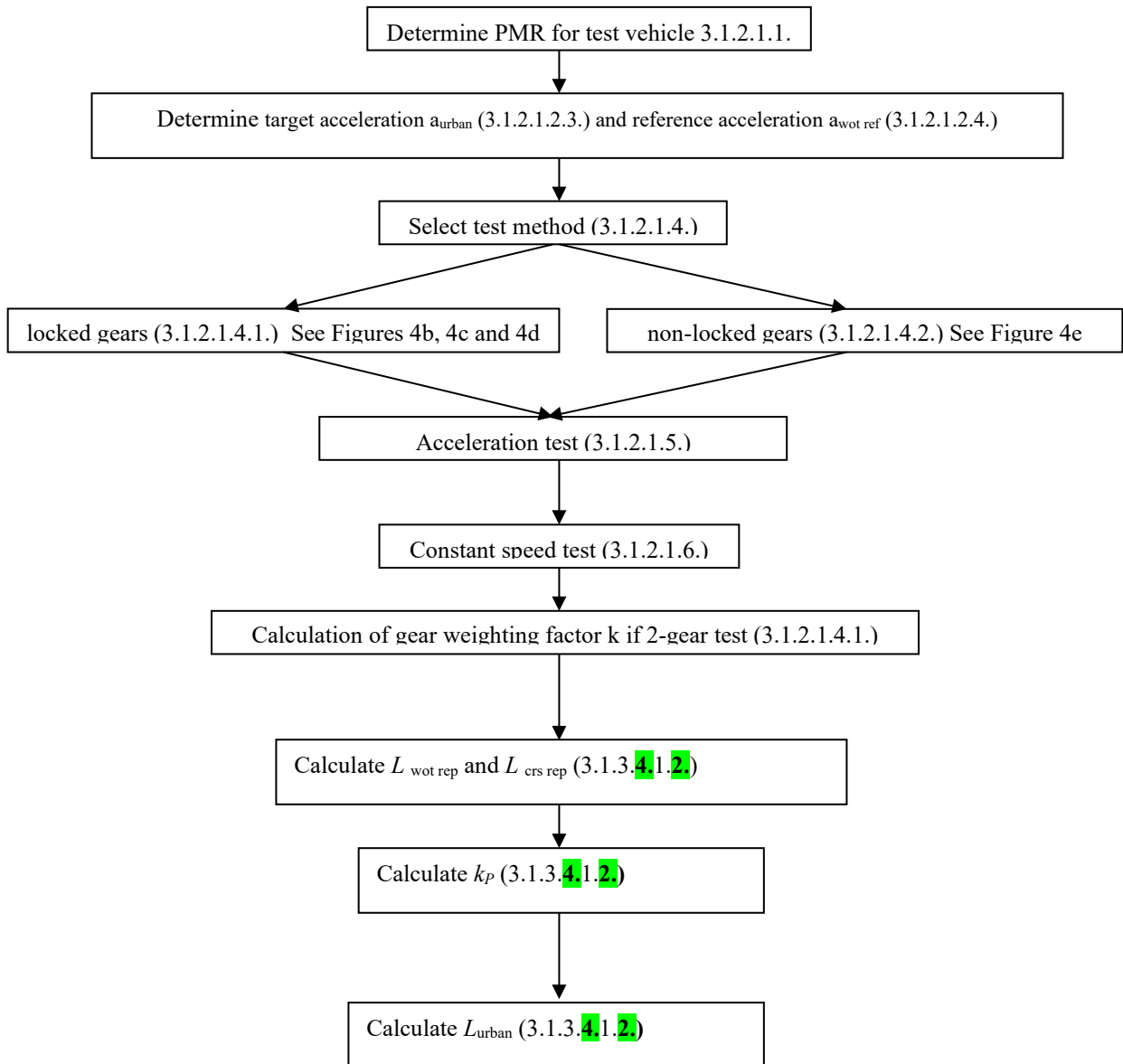
In cases where $L_{wot,rep}$ is less than $L_{crs,rep}$ the final result L_{urban} is the result of the cruise test:

$$L_{urban} = L_{crs,rep}$$

Annex 3, Appendix 1, Figure 4a, amend to read:

"Figure 4a

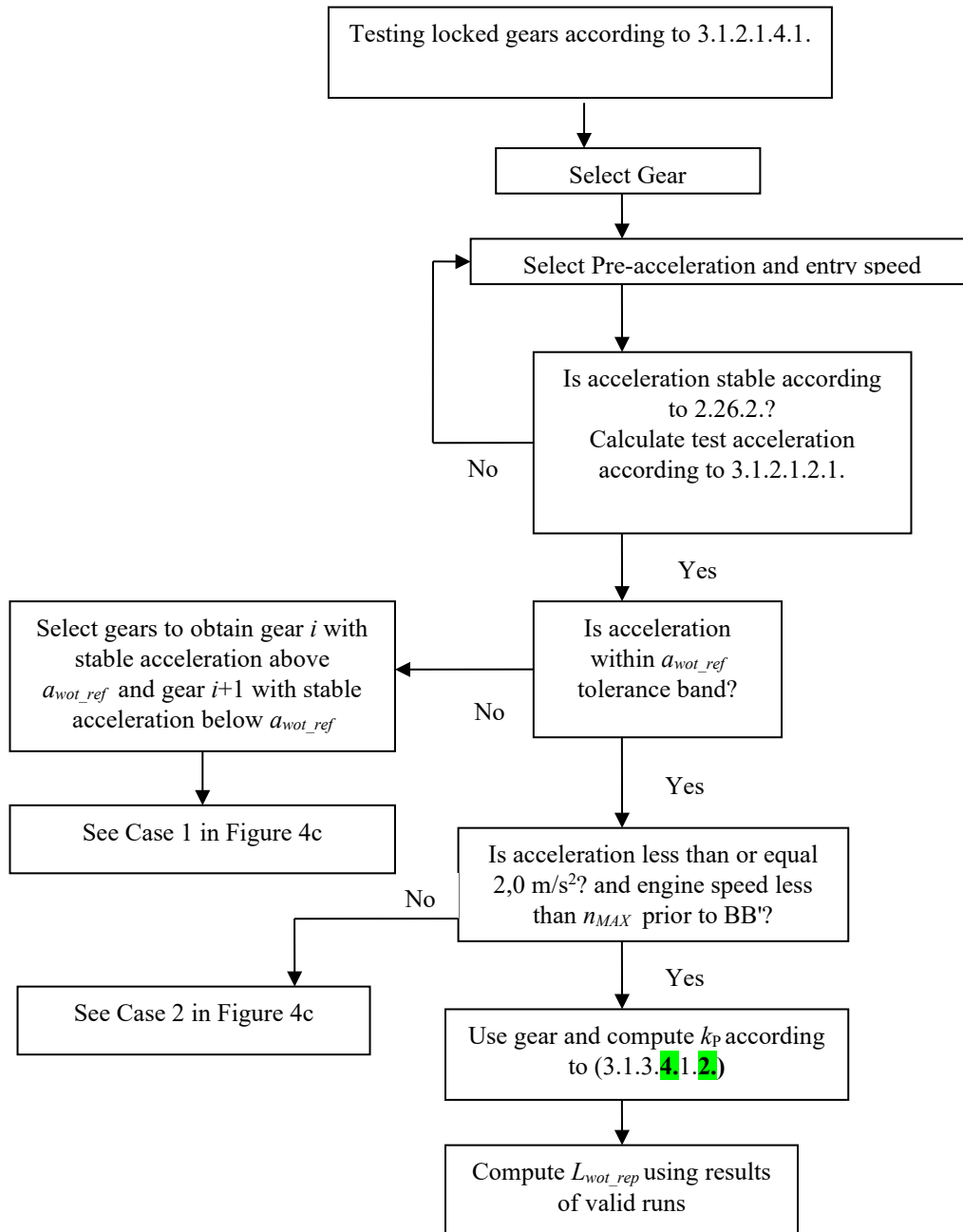
Flowchart for vehicles tested according to paragraph 3.1.2.1. of Annex 3 to this Regulation – L_{urban} computation



Annex 3, Appendix 1, Figure 4b, amend to read:

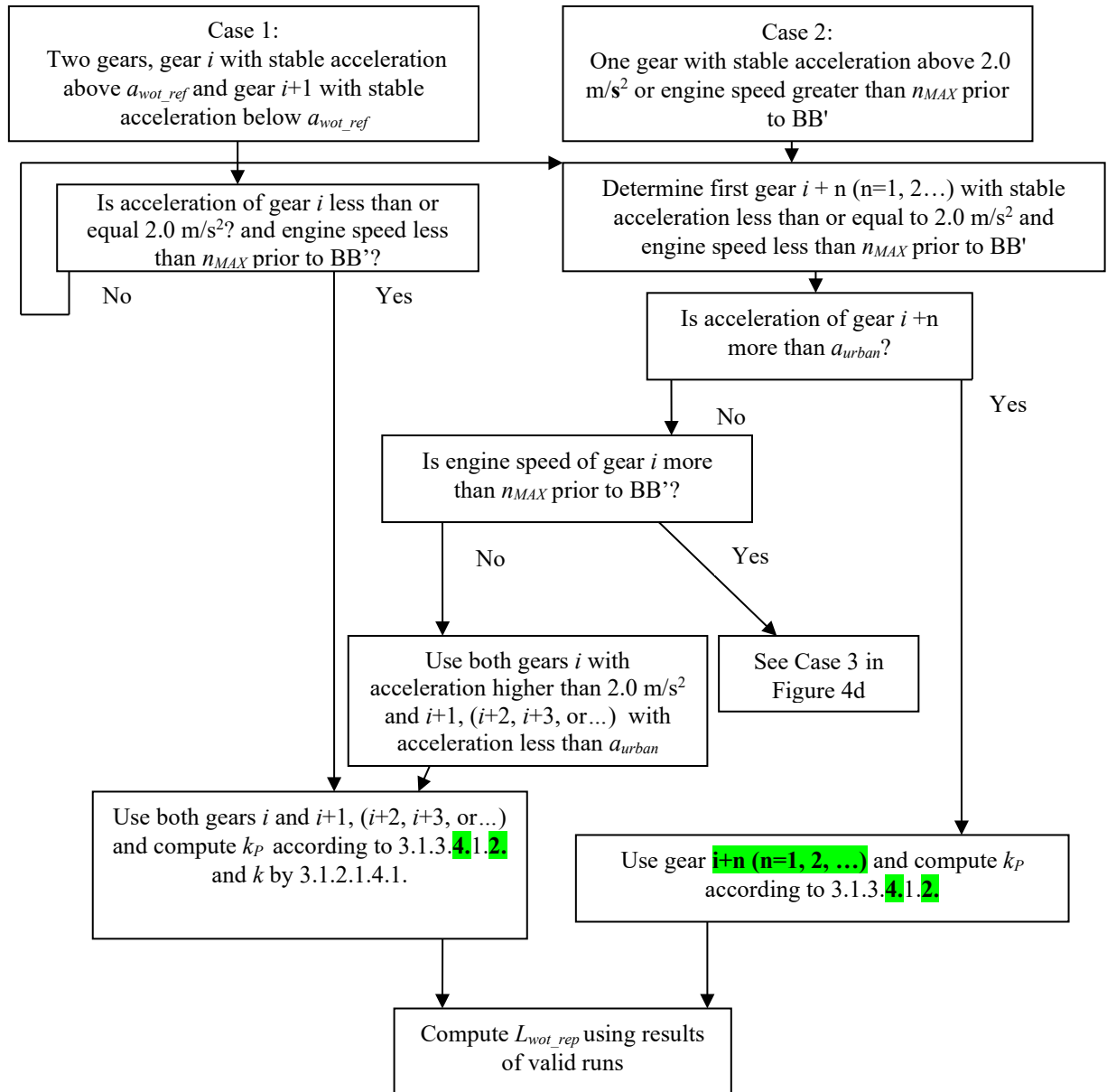
"Figure 4b

Flowchart for vehicles tested according to paragraph 3.1.2.1. of Annex 3 to this Regulation - Gear selection using locked gear PART 1



Annex 3 – Appendix 1, Figure 4c, amend to read:

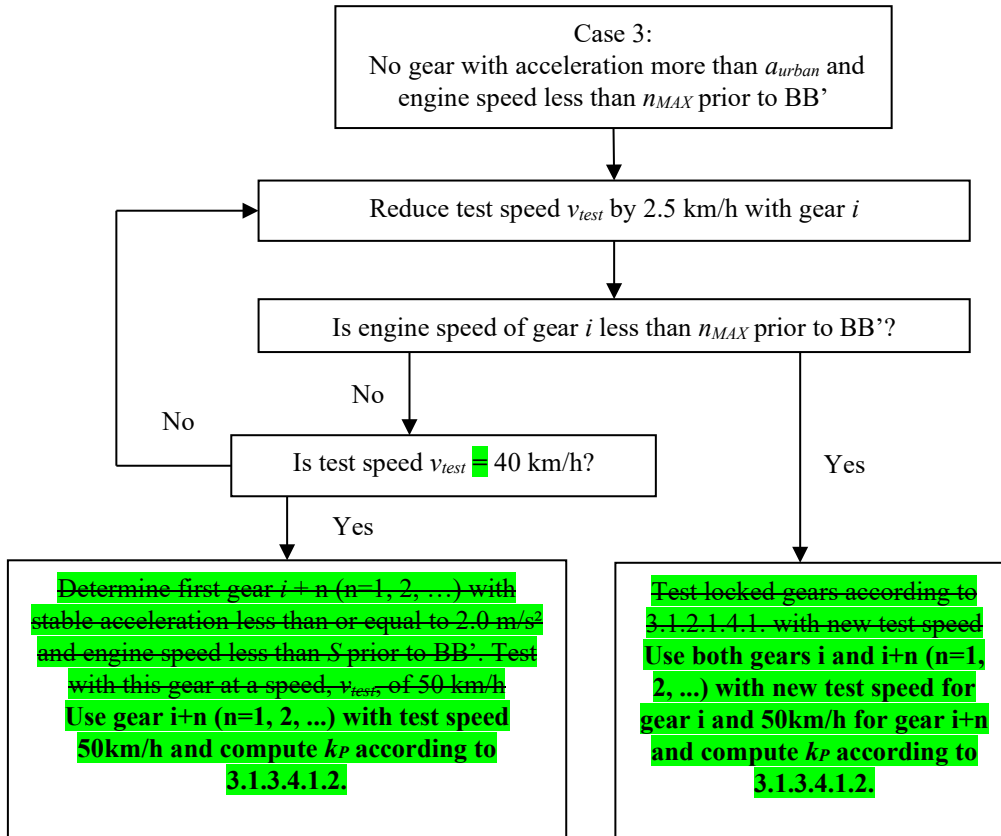
"Figure 4c
**Flowchart for vehicles tested according to paragraph 3.1.2.1. of Annex 3 to this Regulation –
 Gear selection using locked gear PART 2**



Annex 3 – Appendix 1, Figure 4d, amend to read:

"Figure 4d

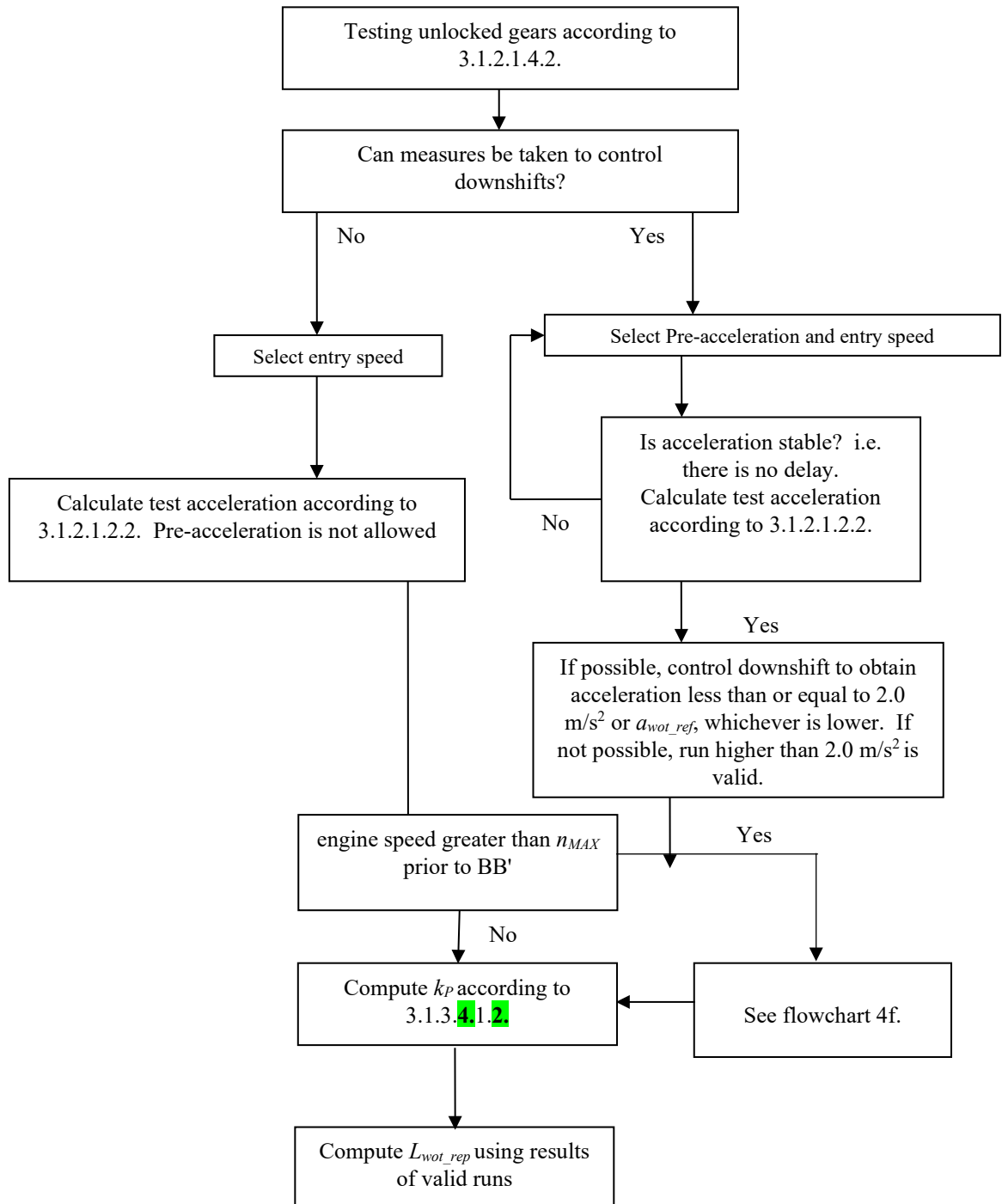
Flowchart for vehicles tested according to paragraph 3.1.2.1. of Annex 3 to this Regulation – Gear selection using locked gear PART 3



Annex 3 – Appendix 1, Figure 4e, amend to read:

"Figure 4e

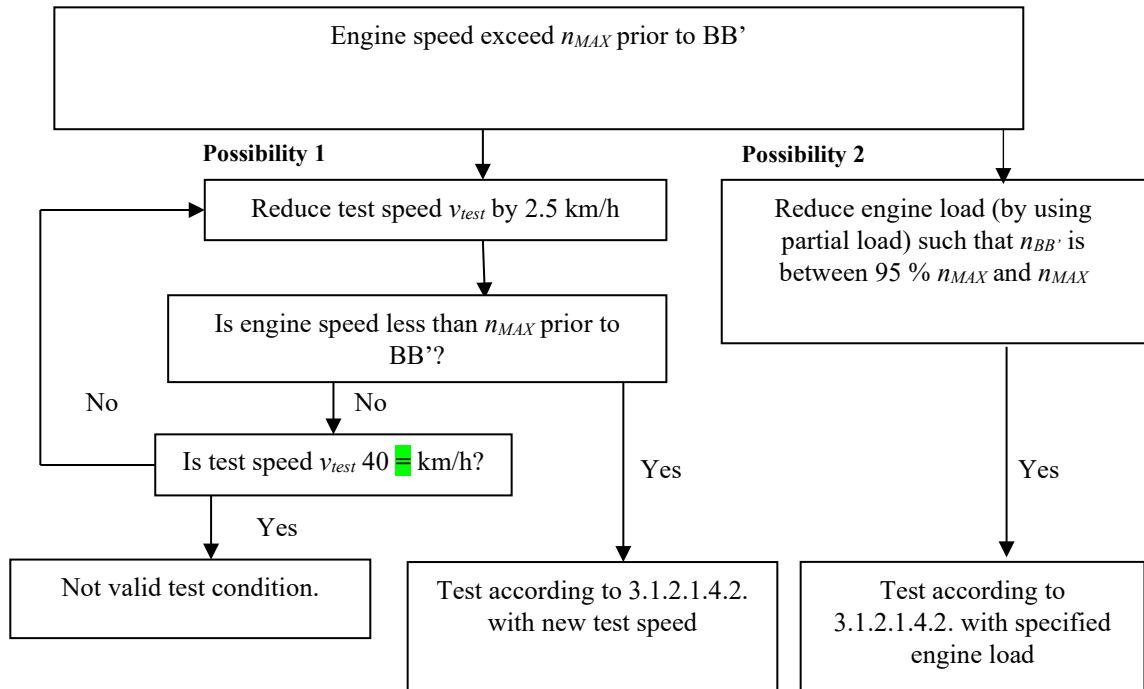
Flowchart for vehicles tested according to paragraph 3.1.2.1. of Annex 3 to this Regulation Gear Selection using non-locked gears



Annex 3 – Appendix 1, Figure 4f, amend to read:

“Figure 4f

Flowchart for vehicles tested according to paragraph 3.1.2.1.4.2. of Annex 3 to this Regulation – Gear Selection using non-locked gears



Annex 3, Appendix 2, paragraph 2., amend to read:

2. General (see the flowcharts in this Appendix 2, Figure 7a to Figure 7d-7c)
- This Appendix provides correction for temperature and test track dependent on the tyre category and purpose.
- For the correction, tyre rolling sound reference values are needed. Tyre rolling sound measurements shall be carried out according to the test procedure of Appendix 3 to Annex 3 of this regulation.

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.

$$L_{PT,wot,j} = 10 \times \lg(10^{0,1 \times L_{wot,j}} - 10^{0,1 \times L_{TR,wot,j,\theta_{wot}}})$$

In case that $L_{TR,wot,j,\theta_{wot}}$ is greater than $L_{wot,j}$:

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

$$L_{PT,wot,j} = 10 \times \lg(0,01 \times 10^{0,1 \times L_{wot,j}})$$

- (b) the tyre component $L_{TR,wot,j,\theta_{ref}}$ is determined by

$$L_{TR,wot,j,\theta_{ref}} = L_{TR,\theta_{ref},v_{TR,ref}} ”$$

Annex 3, Appendix 3, paragraph 5.1.4.1., amend to read:

“5.1.4.1. Date of track certification to ISO 10844: 2014/2021*:”

* **Delete what does not apply according to the transitional provisions in this Regulation.**

Annex 9, Appendix 4, formula 3.2.4.4.2. No.2, amend to read:

$$n_{CRSACC_ANCHOR} = (v_{TEST}/30-20) \times 1000$$

Annex 9, Appendix 4, formula 3.4. No.2, amend to read:

$$L_{PT_EXP} = \theta_{PT_HI} \times \lg\left(\frac{(n_{BB_TEST} + n_{SHIFT_PT})}{(n_{BB_CRS_ANCHOR} + n_{SHIFT_PT})}\right) + L_{REF_PT}$$

$$L_{PT_EXP} = \theta_{PT_HI} \times \lg\left(\frac{(n_{BB_TEST} + n_{SHIFT_PT})}{(n_{BB_CRS_ANCHOR} + n_{SHIFT_PT})}\right) + L_{REF_PT}$$

II. Justification

Measurement Uncertainties

1. The temperature correction in Supplement 7 is based on the sound behavior of internal combustion engine (ICE) vehicles. Due to their powertrain noise, the sound emission in accelerating condition is always higher than in cruising condition.

For battery electric vehicles (BEVs) the dominant source is the tyre road noise. For this reason, the sound emission in cruising may be higher than during acceleration. In this case the current temperature correction will be inaccurate and cause an additional burden to the BEVs.

Since the standard ISO 362, which describes the basic measuring method of this Regulation, is based on the experience of ICE vehicles, now it must reflect the transformation to BEVs, including this specific case in its future work. The result of this work will probably lead to a new series of amendments to this Regulation.

In the meantime, the proposed Supplement 8 will reduce this additional burden to BEVs regarding the introduction of stage 3 limits, which will enter into force on 1 July 2024.

Paragraph 2.24.

2. The content of paragraph 3.1.3.1. was moved to paragraph 3.1.3.4.1.2. without any change when the measurement uncertainties and the real driving additional sound emission provisions (RD-ASEP) were introduced in Supplement 7. In the table of symbols, the references to this paragraph 3.1.3.1. need to be renumbered to 3.1.3.4.1.2., accordingly.

Paragraph 11.14.

3. Since the changes are referring to supplement 7 the timing of this corrections can be the same.

Annex 3, paragraph 3.1.2.1.1.

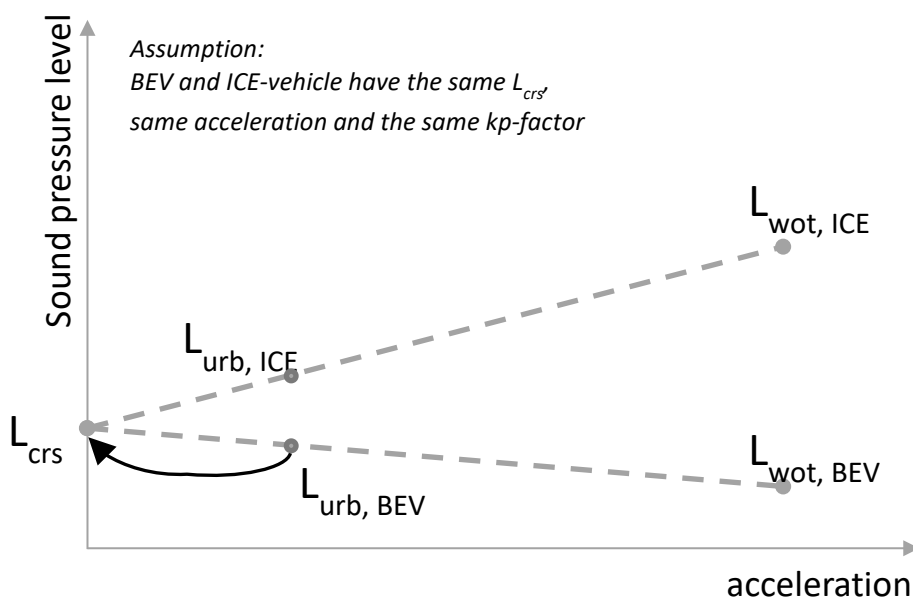
4. With Supplement 7, the definition of "Maximum net power, P_n " in paragraph 2.8. has been adjusted for better clarity. It is therefore proposed to amend the text in the definition of power to mass ratio index (PMR), to align it with the adjustment in Supplement 7.

Annex 3, paragraph 3.1.2.1.3.

5. The content of paragraph 3.1.3.1. was moved to paragraph 3.1.3.4.1.2. without any change when RD-ASEP was introduced in Supplement 7. In paragraph 3.1.2.1.3., the reference to this paragraph 3.1.3.1. needs to be renumbered to 3.1.3.4.1.2., accordingly.

Annex 3, paragraph 3.1.3.4.1.2.

6. To avoid confusion due to a reported value of L_{urban} , which may be smaller than L_{crs} in this special case, L_{urban} is set to L_{crs} , as shown in the diagram below.



Annex 3, Appendix 1, Figures 4a to 4f

7. The content of paragraph 3.1.3.1. was moved to paragraph 3.1.3.4.1.2. without any change when RD-ASEP was introduced in Supplement 7. In the figures, references to this paragraph 3.1.3.1. need to be renumbered to 3.1.3.4.1.2., accordingly.

Additional clarifications

8. In Figure 4c, from the current wording in Annex 3, paragraph 3.1.2.1.4.1.(c), the addition of "i+n (n=1, 2, ...)" in the box "Use gear and compute k_p according to 3.1.3.4.1.2." was made for better understanding and clarification.

9. In Figure 4d, to avoid misinterpretation, the following modifications were made from the current wording in Annex 3, paragraph 3.1.2.1.4.1.(d) for clarification and better understanding:

- Adding "=" in the box "Is test speed v_{test} 40km/h".
- Replacing "Determine first gear $i + n$ (n=1, 2, ...) with stable acceleration less than or equal to 2.0 m/s² and engine speed less than S prior to BB". Test with this gear at

a speed, v_{test} , of 50 km/h” by “Use gear $i+n$ ($n=1, 2, \dots$) with test speed 50km/h and compute k_p according to 3.1.3.4.1.2”.

- Replacing “Test locked gears according to 3.1.2.1.4.1. with new test speed” by “Use both gears i and $i+n$ ($n=1, 2, \dots$) with new test speed for gear i and 50km/h for gear $i+n$ and compute k_p according to 3.1.3.4.1.2.”

10. In Figure 4f, from the current wording in Annex 3, paragraph 3.1.2.1.4.2., the addition of “=” in the box “Is test speed v_{test} 40km/h” was made for better understanding and clarification.

Annex 3, Appendix 2, paragraph 2

11. The reference numbers for the figures have to be corrected: ‘Figure 7a to Figure 7c’ instead of ‘Figure 7a to Figure 7d’.

Annex 3, Appendix 2, paragraph 3.3.4

12. Since the main burden in the temperature correction is caused by an incorrect speed correction of the tyre rolling sound $L_{TR,wot,j,9_{ref}}$, the speed correction according to Annex 3, Appendix 2 paragraph 3.3.1 is not applied in this special case.

ISO-Standard on test tracks

Annex 3, paragraph 2.1.1. and Annex 3, Appendix 3, paragraph 5.1.4.1.

13. ISO has updated the 10844 standard to improve clarity. The primary objective is to reduce track-to-track variability caused by differing interpretations and implementations of the technical requirements. The following table includes other improvements that have been made.

<i>3rd edition ISO 10844:2014 technical method</i>	<i>Improvements in ISO 10844:2021</i>	<i>Effect of improvements</i>
Measurement of irregularity	Permit more modern and accurate methods of measurement (e.g. laser methods) in addition to straight-edge	Improved practicality and accuracy of irregularity measurement
Periodic check criteria for irregularity of tracks exclusively for testing heavy vehicles	Irregularity requirement changed to 10 mm in consideration of permanent deformation caused by heavy vehicles, and through acoustical analysis of potential shielding found negligible impact	Improved durability of tracks used exclusively for heavy vehicles without impacting acoustical measurement
Step requirement	Implement a step requirement that includes allowance for a step-up of maximum 5 mm to harmonize with irregularity requirement	Improved constructability while maintaining same surface geometric tolerances
Sieving curve	Replace sieving curve figure with equivalent tabulation of sieve values defining an aggregate grading envelope	Reduced track-to-track variability caused by subjective interpretation of sieving curve figure
Expected Noise Due to Texture (ENDt) method	Replace optional calculation of ENDt with optional calculation of texture skewness, shape factor (g-factor), and texture spectrum	Skewness, shape factor (g-factor), and texture spectrum reported to correlate with measured pass-by noise, and are proposed for track correlation methods
Sampling for aggregate grading	Sampling of loose asphalt mixture as alternative to coring for evaluating aggregate grading	Sampling of loose asphalt mixture is more practical and representative compared to the small sample extracted from four cores

<i>3rd edition ISO 10844:2014 technical method</i>	<i>Improvements in ISO 10844:2021</i>	<i>Effect of improvements</i>
Examples of track construction	Examples have been removed	Avoided conflicts and confusion in interpretation of the technical requirements in the standard

Annex 9, Appendix 4, formula 3.2.4.4.2 No.2

14. Because of the wrong copy/paste of the formula, it has to be adjusted to the existing wording in Annex 9, Appendix 1 as approved through the adoption of Supplement 7.

Annex 9, Appendix 4, Formula 3.4. No.2

15. The subscript characters have to be corrected and put at the 'right' level, i.e. all at the same level.
