Economic and Social Council

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Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

189th session
Geneva, 7-9 March 2023
Item 4.6.1 of the provisional agenda
1958 Agreement:
Consideration of draft amendments to existing
UN Regulations submitted by GRBP

Proposal for Supplement 8 to the 03 series of amendments to UN Regulation No. 51

Submitted by the Working Party on Noise and Tyres*

The text reproduced below was adopted by the Working Party on Noise and Tyres (GRBP) at its seventy-sixth session (ECE/TRANS/WP.29/GRBP/74, paras. 3 and 6). It is based on ECE/TRANS/WP.29/GRBP/2022/16 as amended by informal document GRBP-76-09 and ECE/TRANS/WP.29/GRBP/2022/13. It also includes further minor corrections as contained in ECE/TRANS/WP.29/GRBP/2023/12. The proposal is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Administrative Committee (AC.1) for consideration at their March 2023 sessions.

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* In accordance with the programme of work of the Inland Transport Committee for 2023 as outlined in proposed programme budget for 2023 (A/77/6 (Sect. 20), table 20.6), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

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Paragraph 2.24., amend to read:

"2.24   Table of symbols

…	…	…	…	…
$L_{crs\,(i)}$	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
$L_{crs\,(i+1)}$	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
$L_{crs\,rep}$	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 11.14. and 11.15., 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 10844:2021."

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 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.

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

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 kg technically permissible maximum laden mass

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

Paragraph 3.1.3.4.1.2., amend to read:

"3.1.3.4.1.2.   […]

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

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

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:

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

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}:

$k_P = 0$

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

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

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

```
        ┌─────────────────────────────────────────────────┐
        │   Determine PMR for test vehicle 3.1.2.1.1.      │
        └─────────────────────────────────────────────────┘
                              │
                              ▼
  ┌──────────────────────────────────────────────────────────────────────┐
  │ Determine target acceleration a_urban (3.1.2.1.2.3.) and reference     │
  │ acceleration a_wot ref (3.1.2.1.2.4.)                                   │
  └──────────────────────────────────────────────────────────────────────┘
                              │
                              ▼
              ┌─────────────────────────────────┐
              │   Select test method (3.1.2.1.4.)│
              └─────────────────────────────────┘
                  ╱                        ╲
                 ▼                          ▼
  ┌────────────────────────────────┐  ┌──────────────────────────────────┐
  │ locked gears (3.1.2.1.4.1.)    │  │ non-locked gears (3.1.2.1.4.2.)  │
  │ See Figures 4b, 4c and 4d      │  │ See Figure 4e                     │
  └────────────────────────────────┘  └──────────────────────────────────┘
                 ╲                          ╱
                  ▼                        ▼
              ┌─────────────────────────────────┐
              │ Acceleration test (3.1.2.1.5.)  │
              └─────────────────────────────────┘
                              │
                              ▼
              ┌─────────────────────────────────┐
              │ Constant speed test (3.1.2.1.6.)│
              └─────────────────────────────────┘
                              │
                              ▼
  ┌──────────────────────────────────────────────────────────────────────┐
  │ Calculation of gear weighting factor k if 2-gear test (3.1.2.1.4.1.)  │
  └──────────────────────────────────────────────────────────────────────┘
                              │
                              ▼
  ┌──────────────────────────────────────────────────────────────────────┐
  │ Calculate L_wot rep and L_crs rep (3.1.3.4.1.2.)                       │
  └──────────────────────────────────────────────────────────────────────┘
                              │
                              ▼
              ┌─────────────────────────────────┐
              │   Calculate k_P (3.1.3.4.1.2.)  │
              └─────────────────────────────────┘
                              │
                              ▼
              ┌─────────────────────────────────┐
              │ Calculate L_urban (3.1.3.4.1.2.)│
              └─────────────────────────────────┘
```

"

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**

```
                    ┌──────────────────────────────────────────┐
                    │  Testing locked gears according to 3.1.2.1.4.1. │
                    └──────────────────────────────────────────┘
                                      │
                                      ▼
                              ┌─────────────────┐
                              │   Select Gear   │
                              └─────────────────┘
                                      │
                                      ▼
                    ┌──────────────────────────────────────────┐
          ┌────────▶│  Select Pre-acceleration and entry speed  │
          │         └──────────────────────────────────────────┘
          │                           │
          │                           ▼
          │         ┌──────────────────────────────────────────┐
          │   No    │  Is acceleration stable according          │
          └─────────│  to 2.26.2.?                                │
                    │  Calculate test acceleration                │
                    │  according to 3.1.2.1.2.1.                  │
                    └──────────────────────────────────────────┘
                                      │ Yes
                                      ▼
┌────────────────────────┐         ┌─────────────────┐
│ Select gears to obtain  │   No    │  Is acceleration │
│ gear i with             │◀────────│  within a_wot_ref │
│ stable acceleration     │         │  tolerance band? │
│ above a_wot_ref and gear│         └─────────────────┘
│ i+1 with stable         │                  │ Yes
│ acceleration below      │                  ▼
│ a_wot_ref               │         ┌──────────────────────────────┐
└────────────────────────┘    No   │  Is acceleration less than or  │
             │          ◀──────────│  equal 2,0 m/s²? and engine     │
             ▼                      │  speed less than n_MAX prior    │
┌────────────────────────┐         │  to BB'?                         │
│  See Case 1 in Figure 4c │         └──────────────────────────────┘
└────────────────────────┘                  │ Yes
                                             ▼
┌────────────────────────┐         ┌──────────────────────────────┐
│  See Case 2 in Figure 4c │         │  Use gear and compute k_P      │
└────────────────────────┘         │  according to 3.1.3.4.1.2.      │
                                    └──────────────────────────────┘
                                             │
                                             ▼
                                    ┌──────────────────────────────┐
                                    │  Compute L_wot_rep using results│
                                    │  of valid runs                  │
                                    └──────────────────────────────┘
```

"

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**

Case 1:	Case 2:
Two gears, gear *i* with stable acceleration above a_{wot_ref} and gear *i*+1 with stable acceleration below a_{wot_ref}	One gear with stable acceleration above 2.0 m/s^2 or engine speed greater than n_{MAX} prior to BB'

Is acceleration of gear *i* less than or equal 2.0 m/s^2? and engine speed less than n_{MAX} prior to BB'?

No   Yes

Determine first gear *i* + n (n=1, 2…) with stable acceleration less than or equal to 2.0 m/s^2 and engine speed less than n$_{MAX}$ prior to BB'

Is acceleration of gear *i* +n more than a_{urban}?

No   Yes

Is engine speed of gear *i* more than n_{MAX} prior to BB'?

No   Yes

Use both gears *i* with acceleration higher than 2.0 m/s^2 and *i*+1, (*i*+2, *i*+3, or...) with acceleration less than a_{urban}

See Case 3 in Figure 4d

Use both gears *i* and *i*+1, (*i*+2, *i*+3, or...) and compute k_P according to 3.1.3.4.1.2. and *k* by 3.1.2.1.4.1.

Use gear i+n (n=1, 2, …) and compute k_P according to 3.1.3.4.1.2.

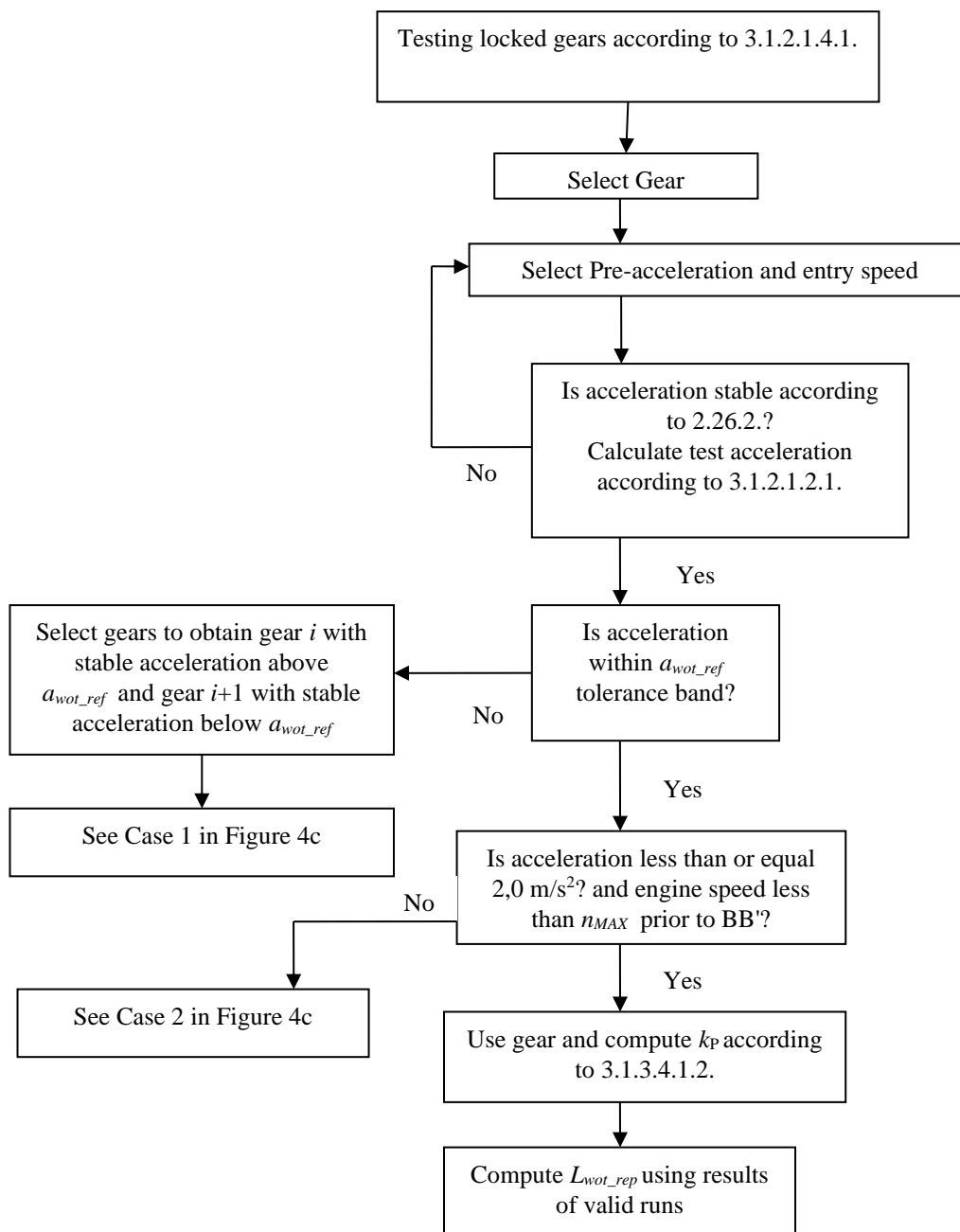Compute L_{wot_rep} using results of valid runs
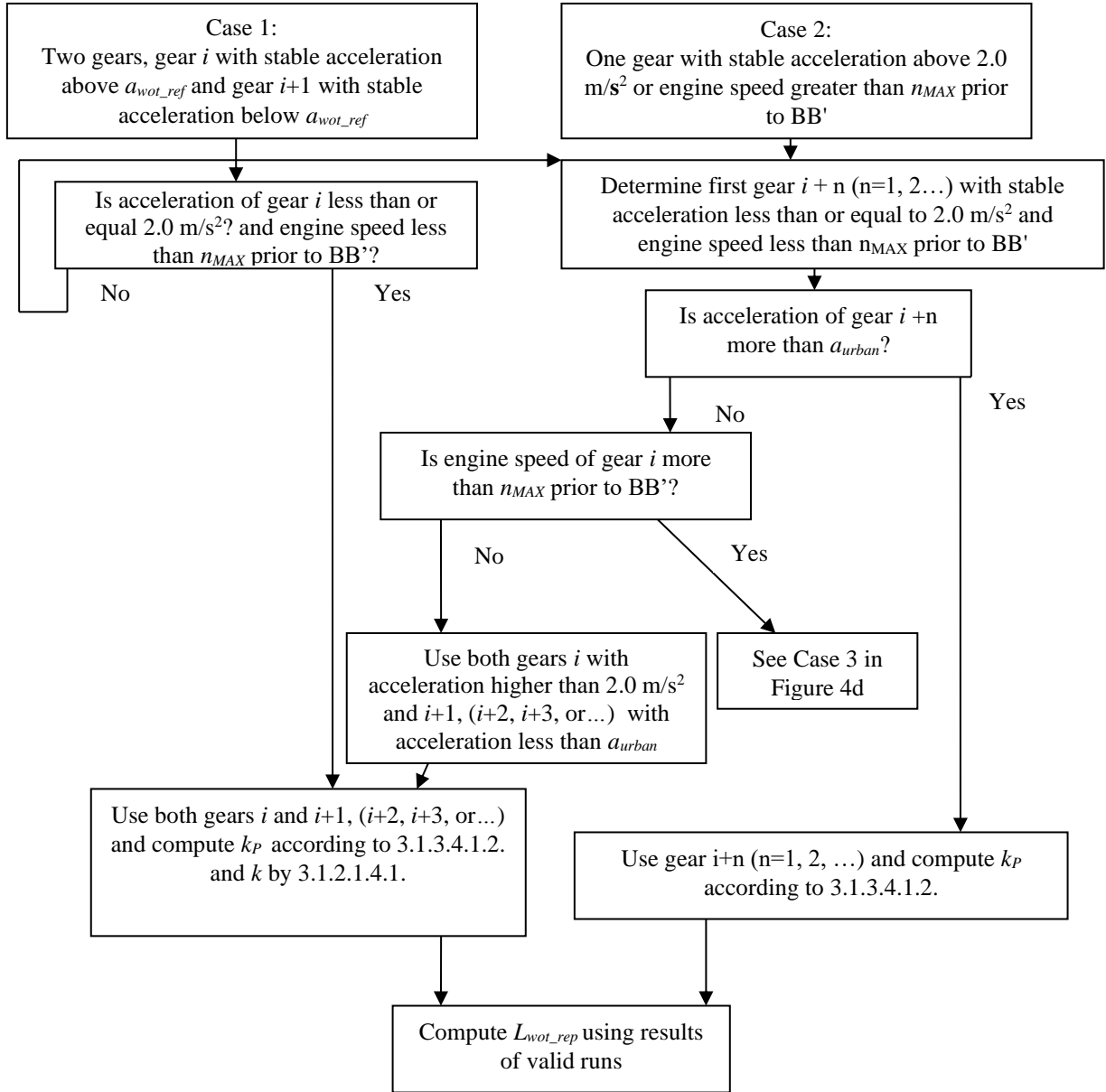
"

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
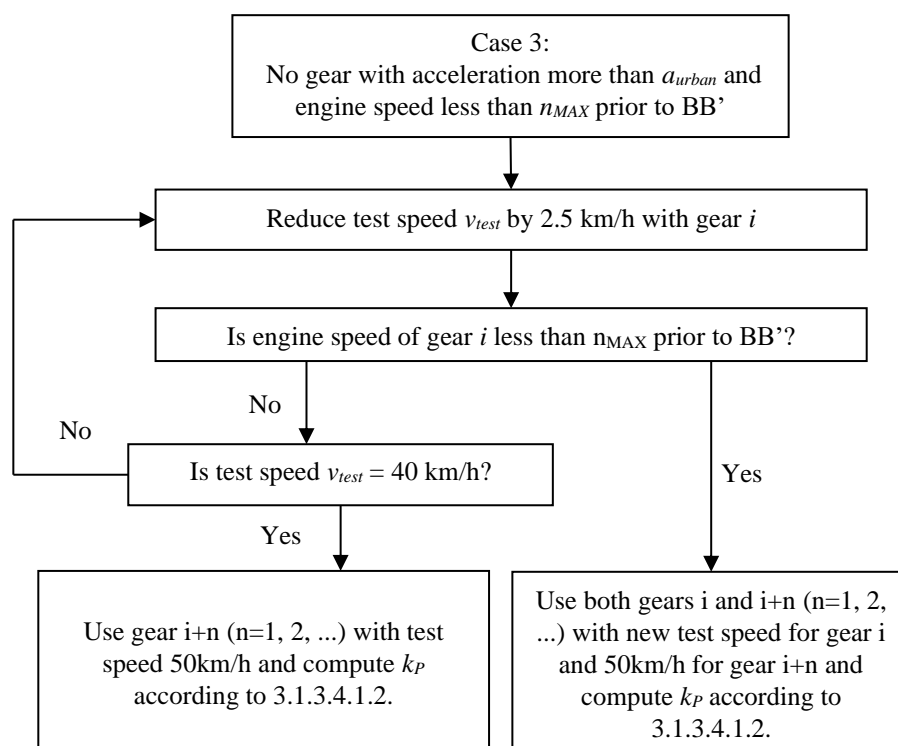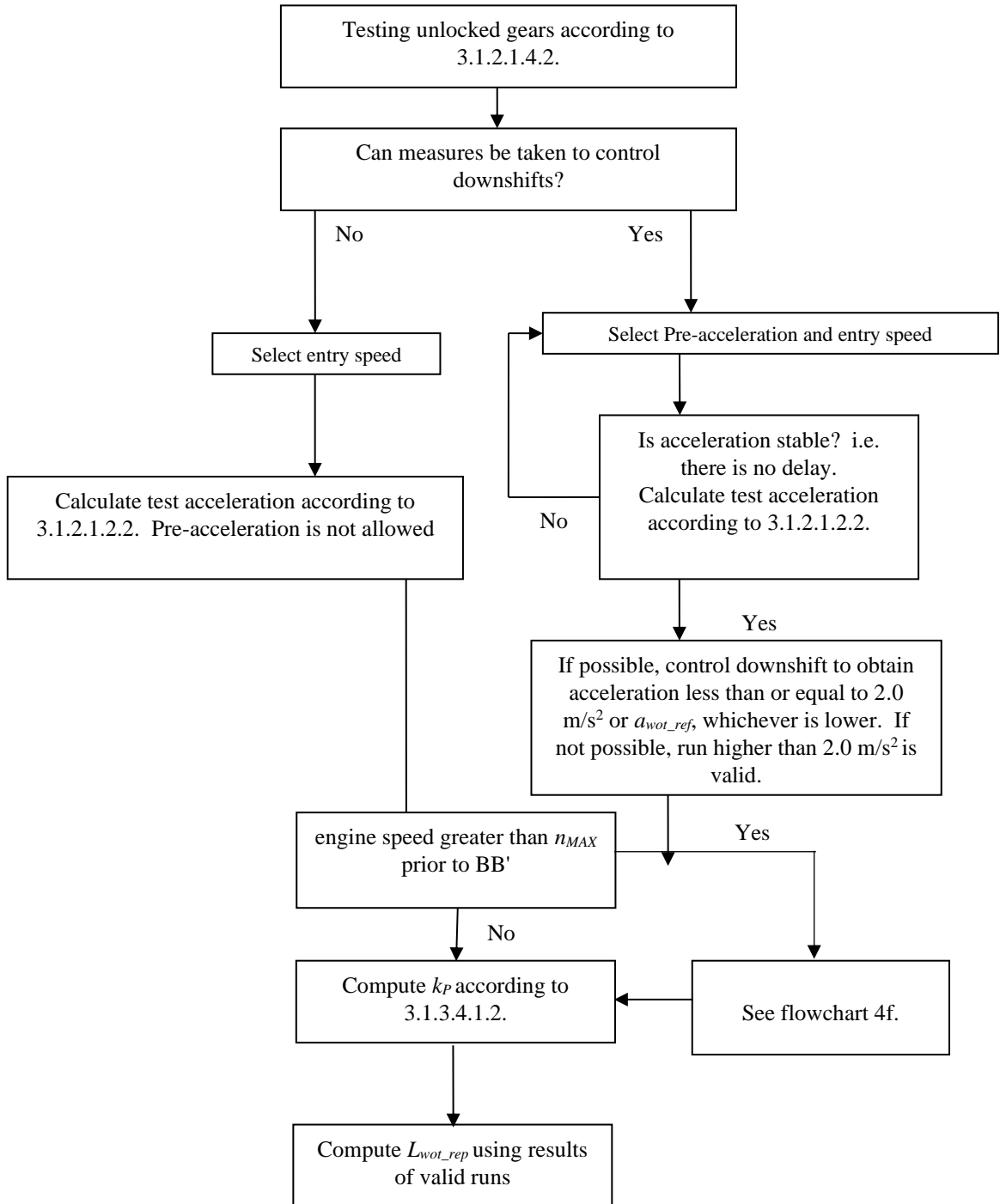
Figure 4e, amend to read:
"Figure 4e
Flowchart for vehicles tested according to paragraph 3.1.2.1. of Annex 3 to this Regulation Gear Selection using non-locked gears
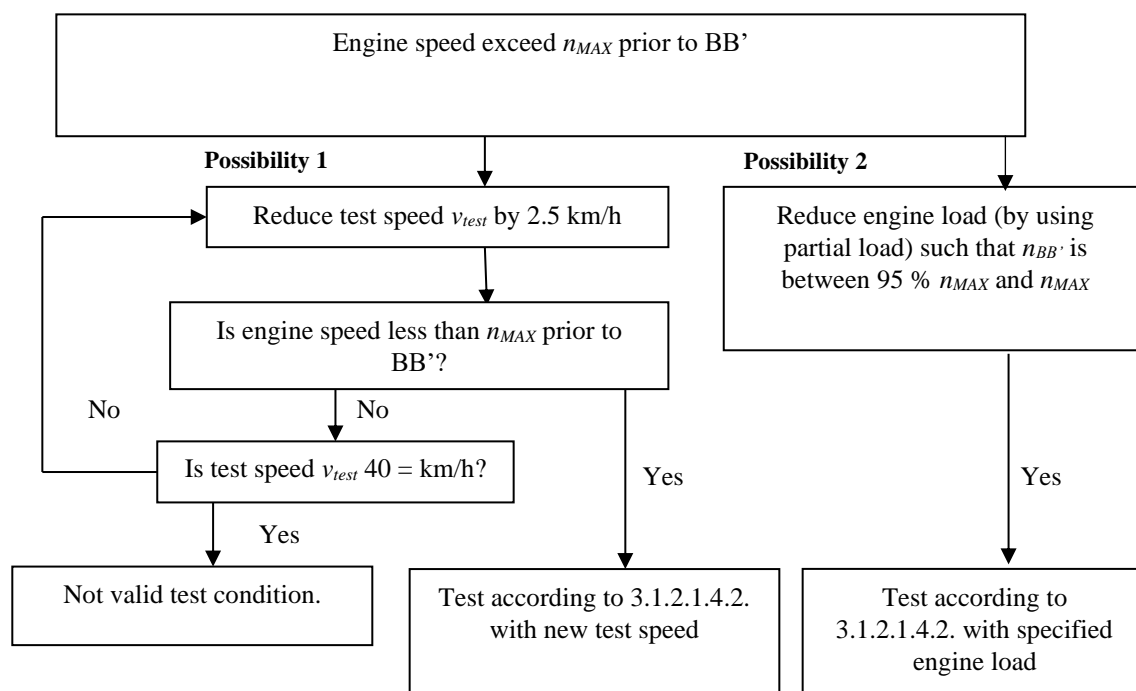
```
                    ┌─────────────────────────────────┐
                    │  Testing unlocked gears          │
                    │  according to 3.1.2.1.4.2.       │
                    └─────────────────────────────────┘
                                  │
                    ┌─────────────────────────────────┐
                    │  Can measures be taken to control│
                    │  downshifts?                     │
                    └─────────────────────────────────┘
                       No                    Yes
                       │                      │
          ┌────────────────────┐   ┌─────────────────────────────┐
          │  Select entry speed│   │ Select Pre-acceleration and │
          └────────────────────┘   │ entry speed                 │
                       │           └─────────────────────────────┘
                       │                      │
          ┌────────────────────────┐  ┌──────────────────────────┐
          │ Calculate test         │  │ Is acceleration stable?  │
          │ acceleration according │  │ i.e. there is no delay.  │ No
          │ to 3.1.2.1.2.2.        │  │ Calculate test           │
          │ Pre-acceleration is    │  │ acceleration according   │
          │ not allowed            │  │ to 3.1.2.1.2.2.          │
          └────────────────────────┘  └──────────────────────────┘
                       │                      │ Yes
                       │           ┌──────────────────────────────┐
                       │           │ If possible, control         │
                       │           │ downshift to obtain          │
                       │           │ acceleration less than or    │
                       │           │ equal to 2.0 m/s² or         │
                       │           │ a_wot_ref, whichever is      │
                       │           │ lower. If not possible, run  │
                       │           │ higher than 2.0 m/s² is valid│
                       │           └──────────────────────────────┘
          ┌────────────────────────┐            │
          │ engine speed greater   │  Yes        │
          │ than n_MAX prior to BB'│─────────┐   │
          └────────────────────────┘         │   │
                       │ No                   │   │
          ┌────────────────────────┐   ┌──────────────────┐
          │ Compute k_P according  │◄──│ See flowchart 4f.│
          │ to 3.1.3.4.1.2.        │   └──────────────────┘
          └────────────────────────┘
                       │
          ┌────────────────────────┐
          │ Compute L_wot_rep using│
          │ results of valid runs  │
          └────────────────────────┘
```

The flowchart for vehicles tested according to paragraph 3.1.2.1. of Annex 3:

- **Testing unlocked gears according to 3.1.2.1.4.2.**
- **Can measures be taken to control downshifts?**
  - No → Select entry speed → Calculate test acceleration according to 3.1.2.1.2.2. Pre-acceleration is not allowed
  - Yes → Select Pre-acceleration and entry speed
- **Is acceleration stable? i.e. there is no delay. Calculate test acceleration according to 3.1.2.1.2.2.**
  - No → (back to Select Pre-acceleration and entry speed)
  - Yes → If possible, control downshift to obtain acceleration less than or equal to 2.0 m/s² or a_{wot_ref}, whichever is lower. If not possible, run higher than 2.0 m/s² is valid.
- **engine speed greater than n_{MAX} prior to BB'**
  - Yes → See flowchart 4f.
  - No → Compute k_P according to 3.1.3.4.1.2.
- **Compute L_{wot_rep} using results of valid runs**

"

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

```
                    ┌─────────────────────────────────────────────────┐
                    │        Engine speed exceed n_MAX prior to BB'      │
                    │                                                    │
                    └─────────────────────────────────────────────────┘
        Possibility 1                │              Possibility 2
    ┌──────────────────────────┐     │          ┌──────────────────────────┐
    │ Reduce test speed v_test  │     │          │ Reduce engine load (by    │
    │ by 2.5 km/h               │     │          │ using partial load) such  │
    └──────────────────────────┘     │          │ that n_BB' is between      │
                │                     │          │ 95 % n_MAX and n_MAX       │
    ┌──────────────────────────┐     │          └──────────────────────────┘
    │ Is engine speed less than │     │
    │ n_MAX prior to BB'?        │     │
    └──────────────────────────┘     │
  No            │ No                  │ Yes                    │ Yes
    ┌──────────────────────────┐     │
    │ Is test speed v_test       │     │
    │ 40 = km/h?                 │     │
    └──────────────────────────┘     │
              │ Yes                   │
    ┌──────────────────┐   ┌──────────────────────┐   ┌──────────────────────┐
    │ Not valid test   │   │ Test according to     │   │ Test according to     │
    │ condition.       │   │ 3.1.2.1.4.2. with new │   │ 3.1.2.1.4.2. with     │
    │                  │   │ test speed            │   │ specified engine load │
    └──────────────────┘   └──────────────────────┘   └──────────────────────┘
```

"

Annex 3, Appendix 2,

Paragraph 2., amend to read:

"2.   General (see the flowcharts in this Appendix 2, Figure 7a to Figure 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."

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 $L_{wot,j}$:

(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

$$L_{TR,wot,j,\vartheta_{ref}} = L_{TR,\vartheta_{ref},v_{TR,ref}} \qquad "$$

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:

$$n_{ACC\_ANCHOR} = (v_{TEST}/20) \times 1000$$

Formula 3.4. No.2, amend to read:

$$L_{PT\_EXP} = \theta_{PT\_HI} \times lg((n_{BB'\_TEST} + n_{SHIFT\_PT})/(n_{BB'\_CRS\_ANCHOR} + n_{SHIFT\_PT})) + L_{REF\_PT}$$

_____