Regulation (EU) 2020/740 of the European Parliament and of the Council of 25 May 2020 on the labelling of tyres with respect to fuel efficiency and other parameters, amending Regulation (EU) 2017/1369 and repealing Regulation (EC) No 1222/2009

ANNEX V

LABORATORY ALIGNMENT PROCEDURE FOR THE MEASUREMENT OF ROLLING RESISTANCE

1. Definitions

For the purposes of the laboratory alignment procedure for the measurement of rolling resistance, the following definitions apply:

(1) 'reference laboratory' means a laboratory that is part of the network of laboratories, the names of which have been published in the *Official Journal of the European Union* for the purpose of the laboratory alignment procedure, and that is able to achieve the accuracy of test results determined in Section 3 with its reference machine;

(2) 'candidate laboratory' means a laboratory participating in the laboratory alignment procedure that is not a reference laboratory;

(3) 'alignment tyre' means a tyre that is tested for the purpose of performing the laboratory alignment procedure;

(4) 'alignment tyre set' means a set of five or more alignment tyres for the alignment of one single machine;

(5) 'assigned value' means a theoretical value of the rolling resistance coefficient (RRC) of one alignment tyre as measured by a theoretical laboratory which is representative of the network of reference laboratories that is used for the laboratory alignment procedure;

(6) 'machine' means every tyre testing spindle in one specific measurement method; for example, two spindles acting on the same drum shall not be considered as one machine.

2. General provisions

2.1. Principle

The measured (m) rolling resistance coefficient obtained in a reference laboratory (l), ($RRC_{m,l}$), shall be aligned to the assigned values of the network of reference laboratories.

The measured (m) rolling resistance coefficient obtained by a machine in a candidate laboratory (c), ($RRC_{m,c}$), shall be aligned through one reference laboratory of the network of its choice.

2.2. Tyre selection requirements

Alignment tyre sets shall be selected for the laboratory alignment procedure in accordance with the following criteria. One alignment tyre set shall be selected for C1 tyres and C2 tyres together, and one set for C3 tyres:

(a) the alignment tyre set shall be selected so as to cover the range of different RRCs of C1 tyres and C2 tyres together, or of C3 tyres; in any event, the difference between the highest RRC_m of the alignment tyre set, and the lowest RRC_m of the alignment tyre set shall be, before and after alignment, at least equal to:

  (i) 3 N/kN for C1 tyres and C2 tyres; and

  (ii) 2 N/kN for C3 tyres;

(b) the RRC_m in the candidate or reference laboratories ($RRC_{m,c}$ or $RRC_{m,l}$) based on declared RRC values of each alignment tyre of the alignment tyre set shall be distributed evenly;

(c) load index values shall adequately cover the range of the tyres to be tested, ensuring that the rolling resistance values also cover the range of the tyres to be tested.

Each alignment tyre shall be checked prior to use and shall be replaced when:

(a) the alignment tyre shows a condition which makes it unusable for further tests; or

(b) there are deviations of $RRC_{m,c}$ or $RRC_{m,l}$ greater than 1,5 % relative to earlier measurements after correction for any machine drift.

2.3. Measurement method

The reference laboratory shall measure each alignment tyre four times and retain the three last results for further analysis, in accordance with paragraph 4 of Annex 6 to UNECE Regulation No 117 and under the conditions set out in paragraph 3 of Annex 6 to UNECE Regulation No 117.

The candidate laboratory shall measure each alignment tyre ($n + 1$) times, with n being specified in Section 5 of this Annex and retain the n last results for further analysis, in accordance with paragraph 4 of Annex 6 to UNECE Regulation No 117 and applying the conditions set out in paragraph 3 of Annex 6 to UNECE Regulation No 117.

Each time an alignment tyre is measured, the tyre/wheel assembly shall be removed from the machine and the entire test procedure referred to in paragraph 4 of Annex 6 to UNECE Regulation No 117 shall be followed again from the start.

The candidate or reference laboratory shall calculate:

(a) the measured value of each alignment tyre for each measurement as specified in paragraphs 6.2 and 6.3 of Annex 6 to UNECE Regulation No 117 (i.e. corrected for a temperature of 25 °C and a drum diameter of 2 m);

(b) the mean value of the three last measured values of each alignment tyre (in the case of reference laboratories) or the mean value of the n last measured values of each alignment tyre (in the case of candidate laboratories); and

(c) the standard deviation (σ_m) as follows:

where:

i	is the counter from 1 to p for the alignment tyres;
j	is the counter from 2 to $n + 1$ for the n last repetitions of each measurement of a given alignment tyre;
$n + 1$	is the number of repetitions of tyre measurements ($n + 1 = 4$ for reference laboratories and $n + 1 \geq 4$ for candidate laboratories);
p	is the number of alignment tyres ($p \geq 5$).

2.4. Data formats to be used for the computations and results

The measured RRC values corrected from drum diameter and temperature shall be rounded to two decimal places.

Then the computations shall be made with all digits: there shall be no further rounding except on the final alignment equations.

All standard deviation values shall be displayed to three decimal places.

All RRC values will be displayed to two decimal places.

All alignment coefficients ($A1_l$, $B1_l$, $A2_c$ and $B2_c$) shall be rounded and displayed to four decimal places.

3. Requirements applicable to the reference laboratories and determination of the assigned values

The assigned values of each alignment tyre shall be determined by a network of reference laboratories. Every second year the network shall assess the stability and validity of the assigned values.

Each reference laboratory participating in the network shall comply with the specifications of Annex 6 to UNECE Regulation No 117 and have a standard deviation (σ_m) as follows:

(a) not greater than 0,05 N/kN for C1 tyres and C2 tyres; and

(b) not greater than 0,05 N/kN for C3 tyres.

The alignment tyre sets that have been selected in accordance with Section 2.2 shall be measured in accordance with Section 2.3 by each reference laboratory of the network.

The assigned value of each alignment tyre is the average of the measured values given by the reference laboratories of the network for this alignment tyre.

4. Procedure for the alignment of a reference laboratory to the assigned values

Each reference laboratory (l) shall align itself to each new set of assigned values and always after any significant machine change or any drift in machine control tyre monitoring data.

The alignment shall use a linear regression technique on all individual data. The regression coefficients, $A1_l$ and $B1_l$, shall be calculated as follows:

$$RRC = A1_l \times RRC_{m,l} + B1_l$$

where:

RRC	l	is the assigned value of the rolling resistance coefficient;
$RRC_{m,}$	l	is the individual measured value of the rolling resistance coefficient by the reference laboratory 'l' (including temperature and drum diameter corrections).

5. Requirements applicable to candidate laboratories

Candidate laboratories shall repeat the alignment procedure at least once every second year for every machine and always after any significant machine change or any drift in machine control tyre monitoring data.

A common set of five different tyres that have been selected in accordance with Section 2.2 shall be measured in accordance with Section 2.3 first by the candidate laboratory and then by one reference laboratory. More than five alignment tyres may be tested at the request of the candidate laboratory.

The candidate laboratory shall provide the alignment tyre set to the selected reference laboratory.

The candidate laboratory (*c*) shall comply with the specifications of Annex 6 to UNECE Regulation No 117 and preferably have standard deviations (σ_m) as follows:

(a) not greater than 0,075 N/kN for C1 tyres and C2 tyres; and

(b) not greater than 0,06 N/kN for C3 tyres.

If the standard deviation (σ_m) of the candidate laboratory is higher than those values after four measurements, the last three being used for the computations, then the number $n + 1$ of measurement repetitions shall be increased as follows for the entire batch:

$n + 1 = 1 + (\sigma_m/\gamma)^2$, rounded up to the nearest higher integer value

where:

γ = 0,043 N/kN for C1 tyres and C2 tyres;
γ = 0,035 N/kN for C3 tyres.

6. Procedure for the alignment of a candidate laboratory

One reference laboratory (*l*) of the network shall calculate the linear regression function on all individual data of the candidate laboratory (*c*). The regression coefficients, $A2_c$ and $B2_c$, shall be calculated as follows:

$RRC_{m,l} = A2_c \times RRC_{m,c} + B2_c$

where:

$RRC_{m,l}$ is the individual measured value of the rolling resistance coefficient by the reference laboratory (*l*) (including temperature and drum diameter corrections);

$RRC_{m,c}$ is the individual measured value of the rolling resistance coefficient by the candidate laboratory (*c*) (including temperature and drum diameter corrections)

If the coefficient of determination R^2 is lower than 0,97, the candidate laboratory shall not be aligned.

The aligned *RRC* of tyres tested by the candidate laboratory shall be calculated as follows:

$RRC = (A1_l \times A2_c) \times RRC_{m,c} + (A1_l \times B2_c + B1_l)$