

Proposal for a new supplement to the original version and the 01 series of amendments to UN Regulation No. 154

This document aims to:

- harmonize the KCO2 family concept from UN GTR15 Amendment 6 with this Regulation.
- harmonize the correction of CO₂ results against target speed in Level 1A with Level 1B and the most stringent Level 2.
- delete correction criterion c as it is no longer needed.
- propose a clarification and specification in the ATCT family criteria.

The modifications to the current text of the Regulation are marked in bold for new or strikethrough for deleted characters.

I. Proposal

Paragraph 6.2.6. of Original and 01 series; amend to read:

"6.2.6. Each of the vehicle families specified below shall be attributed a unique identifier of the following format:

FT-nnnnnnnnnnnnnnn-WMI

Where:

FT is an identifier of the family type:

(a) IP = Interpolation family as defined in paragraph 6.3.2. with or without using the interpolation method

(b) RL = Road load family as defined in paragraph 6.3.3.

(c) RM = Road load matrix family as defined in paragraph 6.3.4.

(d) PR = Periodically regenerating systems (Ki) family as defined in paragraph 6.3.5.

(e) AT = ATCT family as defined in paragraph 2. of Annex B6a.

(f) EV = Evaporative emissions family, as defined in paragraph 6.6.3.

(g) DF = Durability family, as defined in paragraph 6.7.5.

(h) OB = OBD family identifier, as defined paragraph 6.8.1.

(i) ER = Exhaust after-treatment system using reagent (ER) family identifier, as defined in paragraph 6.9.2.

(j) GV = GFV family identifier, as defined in paragraph 6.3.6.3.

(k) KC = KCO2 family identifier, as defined in paragraph 6.3.11

nnnnnnnnnnnnnn is a string with a maximum of fifteen characters, restricted to using the characters 0-9, A-Z and the underscore character '_'.

WMI (world manufacturer identifier) is a code that identifies the manufacturer in a unique manner defined in ISO 3780:2009.

It is the responsibility of the owner of the WMI to ensure that the combination of the string nnnnnnnnnnnnnnn and the WMI is unique to the family and that the string nnnnnnnnnnnnnnn is unique within that WMI to the approval tests performed to obtain the approval."

Add a new paragraph 6.3.11. to Original series, to read:

"6.3.11. This paragraph applies to Level 1A only.

K_{CO2} correction factor family for OVC-HEVs and NOVC-HEVs

It is allowed to merge two or more interpolation families into the same K_{CO2} correction factor family at which K_{CO2} shall be determined with vehicle H of one of the included interpolation families. The interpolation family that is used for the vehicle H selection shall be agreed by the responsible authority.

At the request of the responsible authority, the manufacturer shall provide evidence on the justification and technical criteria for merging these interpolation families for example in the following cases:

Two or more interpolation families are merged:

(a) Which were split because the maximum interpolation range of 20 g/km CO₂ is exceeded (in case vehicle M measured: 30g/km);

(b) Which were split due to different engine power ratings of the same physical combustion engine (different power only related to software)

(c) Which were split because the n/v ratios are just outside the tolerance of 8%;

(d) Which were split, but still fulfil all the family criteria of a single IP family.

(e) Which were split because there is different number of powered axles

Different electric energy converters between recharge-plug-in and traction REESS shall not be considered as a criterion in the context of the correction factor family."

Add a new paragraph 6.3.11. to 01 series; to read:

"6.3.11. KCO2 correction factor family for OVC-HEVs and NOVC-HEVs (for 4-phase WLTC only)

It is allowed to merge two or more interpolation families into the same KCO2 correction factor family at which KCO2 shall be determined with vehicle H of one of the included interpolation families. The interpolation family that is used for the vehicle H selection shall be agreed by the responsible authority.

At the request of the responsible authority, the manufacturer shall provide evidence on the justification and technical criteria for merging these interpolation families for example in the following cases:

Two or more interpolation families are merged:

(a) Which were split because the maximum interpolation range of 20 g/km CO₂ is exceeded (in case vehicle M measured: 30g/km);

(b) Which were split due to different engine power ratings of the same physical combustion engine (different power only related to software)

(c) Which were split because the n/v ratios are just outside the tolerance of 8%;

(d) Which were split, but still fulfil all the family criteria of a single IP family.

(e) Which were split because there is different number of powered axles

Different electric energy converters between recharge-plug-in and traction REESS shall not be considered as a criterion in the context of the correction factor family."

Annex B8, Appendix 2, paragraph 2. of Original and 01 series; amend to read:

- "2. Calculation of correction coefficients 2.1. The CO₂ mass emission correction coefficient K_{CO_2} , the fuel consumption correction coefficients $K_{fuel,FCHV}$, as well as, if required by the manufacturer, the phase-specific correction coefficients $K_{CO_2,p}$ and $K_{fuel,FCHV,p}$ shall be developed based on the applicable charge-sustaining Type 1 test cycles. In the case that vehicle H was tested for the development of the correction coefficient for CO₂ mass emission for NOVC-HEVs and OVC-HEVs, the coefficient may be applied to vehicles that fulfil the same interpolation family criteria. **For interpolation families which fulfil the criteria of the K_{CO_2} correction family, defined in paragraph 6.3.11. of this Regulation, the same K_{CO_2} value may be applied.**"

Annex B8, Appendix 2, add a new paragraph 4. to Original and 01 series, amend to read:

- "4. **As an option for the manufacturer, it is allowed to apply $\Delta M_{CO_2,j}$ defined in paragraph 4.5. of Appendix 2 to Annex B6 with the following modification:**
- $\eta_{alternator}$ is the efficiency of the alternator
- 0.67 in case $\Delta E_{REESS,p}$ is negative (corresponds to a discharge)**
- 1.00 in case $\Delta E_{REESS,p}$ is positive (corresponds to a charge)**
- 4.1. **In this case, the corrected charge-sustaining CO₂ mass emission defined in paragraphs 4.1.1.3., 4.1.1.4. and 4.1.1.5. of this annex shall be replaced by $\Delta M_{CO_2,j}$ instead of $K_{CO_2,j} \times EC_{DC,CS,j}$.**"

Annex B6, paragraph 2.8.6. of Original series, amend to read:

- "2.8.6. This paragraph applies to Level 1A only
- Actual vehicle speed sampled with a measurement frequency of 10 Hz together with actual time shall be applied for corrections of CO₂ results against the target speed and distance as defined in Annex B6b. **In the case RMSSE is less than 0.8 km/h, this correction procedure can be skipped on request of manufacturer.**"

Annex B6 - Appendix 2, paragraph 3.4. of Original and 01 series, amend to read:

- "3.4. Correction of CO₂ mass emission over the whole cycle ~~as a function of the correction criterion e~~"

Annex B6 - Appendix 2, paragraph 3.4.1. of Original and 01 series, amend to read:

- "3.4.1. **[reserved]**
- ~~Calculation of the correction criterion e~~
- ~~The correction criterion e is the ratio between the absolute value of the electric energy change $\Delta E_{REESS,j}$ and the fuel energy and shall be calculated using the following equations:-~~

$$c = \left| \frac{\Delta E_{REESS,j}}{E_{fuel}} \right|$$

~~where:
 e is the correction criterion;~~

~~$\Delta E_{REESS,j}$ is the electric energy change of all REESSs over period j determined according to paragraph 4.1. of this appendix, Wh;~~

~~j is, in this paragraph, the whole applicable WLTP test cycle;~~

~~E_{fuel} is the fuel energy according to the following equation:~~

$$E_{fuel} = 10 \times HV \times FC_{nb} \times d$$

~~where:~~

~~E_{fuel} is the energy content of the consumed fuel over the applicable WLTP test cycle, Wh;~~

~~HV is the heating value according to Table A6.App2/1, kWh/l;~~

~~FC_{nb} is the non-balanced fuel consumption of the Type 1 test, not corrected for the energy balance, determined according to"~~

Annex B6b, paragraph 3.5. of Original and 01 series, amend to read:

"3.5. The average RCB corrected CO₂ mass emissions (g/km) for each phase of the applicable WLTC shall be expressed in units g/s using the following equation:

$$M_{CO_2,j} = M_{CO_2,RCB,j} \times \frac{d_{m,j}}{t_j}$$

where:

$M_{CO_2,j}$ is the average CO₂ mass emission of phase j, g/s;

$M_{CO_2,RCB,j}$ is the CO₂ mass emission from step 1 of Table A7/1 of Annex B7 for the considered WLTC phase j corrected in accordance with Appendix 2 to Annex B6, and with the requirement of applying the RCB correction ~~without considering the correction criterion e;~~

$d_{m,j}$ is the actually driven distance of the considered phase j, km;

t_j is the duration of considered phase j, s."

Annex B6a, paragraph 2.1. of Original and 01 series, amend to read:

"2.1. Only vehicles which are identical with respect to all the following characteristics are permitted to be part of the same ATCT Family:

(a) Powertrain architecture (i.e. internal combustion, hybrid, fuel cell, or electric);

(b) Combustion process (i.e. two stroke or four stroke);

(c) Number and arrangement of cylinders;

(d) Method of engine combustion (i.e. indirect or direct injection);

(e) Type of cooling system (i.e. air, water, or oil);

(f) Method of aspiration (i.e. naturally aspirated, or charged);

(g) Fuel for which the engine is designed (i.e. petrol, diesel, NG, LPG, etc.);

(h) Catalytic converter (i.e. three-way catalyst, lean NO_x trap, SCR, lean NO_x catalyst or other(s));

(i) Whether or not a particulate trap is installed; and

(j) Exhaust gas recirculation (with or without, cooled or non-cooled).

In addition the vehicles shall be similar with respect to the following characteristics:

(k) The vehicles shall have a variation in engine cylinder capacity of no more than 30 per cent of the vehicle with the lowest capacity; and

(l) Engine compartment insulation shall be of a similar type regarding material, amount and location of the insulation. Manufacturers shall provide evidence (e.g. by CAD drawings) to the approval authority that for all vehicles in the family, the volume and weight of the insulation material which will be installed is greater than 90 per cent of that of the ATCT measured reference vehicle. **A tolerance of 10% compared to the declared value in volume and weight shall apply for each single component of the overall insulation entity.**

Difference in insulation material and location may also be accepted to be part of a single ATCT family under the condition that the test vehicle can be demonstrated as being the worst case with regards to engine compartment insulation.

If the manufacturer can demonstrate to the Type Approval Authority that it is ensured that the worst case concept is maintained (e.g. tested vehicle has no insulation), or if the ATCT is composed of a single Interpolation Family, the requirements to document the insulation materials may be waived."

II. Justification

1. Integration of K_{CO_2} family concept and the Willans Approach (both for OVC-HEV and NOVC-HEVs) for harmonization with UN GTR15 Amendment 6
2. Correction of CO_2 results against the target speed and distance is only relevant for level 1A. Harmonization of level 1A, 1B and 2 and application of a stringent level 1B and 2 RMSSE limits will make correction of CO_2 results for $RMSSE < 0.8$ km/h unnecessary. Current situation:

RMSSE	Correction	Validity
$RMSSE < 0.8$ km/h	Level 1 A requires correction, level 1B+2 do not require correction	Valid for all levels
0.8 km/h $< RMSSE < 1.3$ km/h	Level 1 A requires correction	Only valid for level 1A with correction
$RMSSE \geq 1.3$ km/h		Not valid for any level

3. Correction criterion c can be deleted as it is no longer needed.
 4. Volume and weight are reported for each single component to allow the assessment of the 90% limit for the overall insulation entity. As a matter of fact, production vehicle cannot satisfy an exact value, manufacturing tolerance for each insulation component must be taken into account.
-