

Technical report on the development of Amendment 4 to global technical regulation No. 2 on the measurement procedure for two-wheeled motorcycles equipped with a positive or compression ignition engine with regard to the emissions of gaseous pollutants, CO₂ emissions and fuel consumption

I. Mandate

1. Amendment 4 to global technical regulation (GTR) No. 2 was developed by the Informal Working Group (IWG) on Environmental and Propulsion Performance Requirements of L-category vehicles (EPPR). The Executive Committee (AC.3) of the 1998 Agreement adopted the authorisation to develop amendments to UN Global Technical Regulation (UN GTR) No. 2 at its 45th session (12 November 2015) (ECE/TRANS/WP.29/AC.3/36/Rev.1).

II. Objectives

2. Harmonisation of test procedures for two-wheeled vehicles equipped with conventional combustion engine technology, but the objectives also includes three-wheeled vehicles and other propulsion types in the next stage of work.
3. The scope of discussions does not cover light four-wheeled vehicles on emission related UN GTRs
4. The IWG first developed requirements for two-wheeled vehicles with conventional combustion engine technology.
5. Progressively other vehicles categories and other propulsion unit types will be considered to be included.
6. Entire revision of UN GTR No 2 to dedicate separate sections to test types I (tailpipe emission after cold start), II (idle / free acceleration emissions) and VII (energy efficiency)
7. Update the GTR for technical progress.

III. Meetings held by Task Forces

8. The proposed text of Amendment 4 to UN GTR No. addressing the points listed in section II above were discussed at length and agreed upon by all participants in numerous Informal Working Group (IWG) meetings. These meeting took the format of eithers face-to-face or audio/web meetings.

IV. Main resolutions agreed by the IWG

In what follows a summary of the main resolutions agreed by the IWG are indicated explaining the reasons of such decisions.

9. Purpose.

This Regulation provides a worldwide-harmonized measurement method for the determination of the levels of gaseous and particulate pollutant emissions at the tailpipe, the emissions of carbon dioxide and the energy efficiency in terms of fuel consumption of two-wheeled motor vehicles that are representative for real world vehicle operation.

10. Applicability.

The Informal Working Group followed the agreed terms of reference and prepared Amendment 4 to UN GTR No. 2 for two-wheeled vehicles under the 1998 Agreement. The IWG will, in due time prepare an equivalent UN Regulation for L-category vehicles in its scope under the 1958 Agreement.

11. Fuels considered.

Only petrol and diesel were considered. India proposed to add alternative fuel to the scope of this UN GTR in order to support their national plans to fully implement any GTR developed under the UNECE umbrella. Nonetheless many Contracting Parties were of the opinion that alternate fuel is not used for two-wheeled vehicles in large scale, adding alternate fuels to the scope of this GTR will increase the work load considering the timeline for formulation of GTR. However, addition of alternate fuel shall be taken up in further revision within the scope of this GTR.

12. Definitions.

The definitions used in this GTR are taken from the draft common definitions incorporated in S.R.1 as well as from the work of the UN VPSD group operating under GRPE with the goal to harmonise high level powertrain definitions and from other international and regional legislation.

13. Vehicle category.

Only two-wheeled vehicles are considered in the scope. Twinned wheel vehicles considered as two-wheeled vehicles are also in the scope, however BEV, HEV and H₂ are not in scope at the moment. Priority was given for two-wheeled vehicles, although some of the Contracting Parties have regional cycle. Hence it was decided to address three-wheeled vehicles at a later stage. In the same line, both India and Japan were having concerns for implementing Class 0 vehicle in domestic regulation due to different maximum speed. Hence it was decided to leave the details of Class 0 vehicles as Contracting Party option.

14. Performance Requirements

Due to the disparity of level of stringencies present in different regions of the world, it was decided to define performance requirements at two levels: Principal performance requirements (or the most stringent ones for two-wheeled motorcycles) equivalent to the emission limits of Regulation (EU) 168/2013 (i.e. EUR 5 levels) and Alternative performance requirements (or less stringent) and corresponding to performances already in application in some Contracting Parties. This approach encourages the Contracting Parties to advance towards the most stringent performance in the shortest possible time without jeopardising their present regulatory framework.

15. Particle Number (PN) Limit.

Although the topic was discussed by the IWG and since the base text do not include PN currently in Regulation (EU) 2019/129 (Euro 5 emission test provisions/technical requirements), it was finally decided not to consider PN emissions in the Amendment 4 to UN GTR 2.

16. Reference fuel.

The principal performance requirements of this UN GTR are based on the use of reference fuels. The use of this standardised reference fuel for determining compliance with the Principal emission limits (norms) is considered as an ideal condition for ensuring the reproducibility of regulatory emission testing, and Contracting Parties are encouraged to use such fuel in their compliance testing. However, the Alternative performance requirements are applicable with the corresponding reference fuels (see points a) and b))

- a) For Type I Principal norms, the reference fuel for PI vehicles shall be either E0 or E5. For Alternative norms, regional reference fuels available in Contracting Parties can be used for Type I test. This decision was taken because according to the data presented by Japan (EPPR-21-Japan proposal GTR2 B2 (E0 Fuel)_171011.pptx), E0 and E5 can be considered equivalent for the tailpipe emissions, even if it is not the case for the power determination.
- b) For Alternate norms, regional reference fuels available with contracting parties can be used for Type I test (Alt A = India BS IV, Alt B = Euro 4 Alt C = Euro 3)

17. Temperature conversion.

After deliberation in EPPR-IWG and exchange with GRPE Chair and IWGs during 75th GRPE session, it was finally agreed that, wherever temperature conversion is required from degrees C to K, the following conversion factor shall be used: $0^{\circ}\text{C} = 273.15 \text{ K}$

18. Use of Super-charger (definition).

Following an exchange via email between the EPPR Secretariat and the WLTP Coordinator, it was agreed not to use only the term “Supercharger”

but to define “Forced Induction System”, as umbrella definition, adding the relevant sub-definitions for "Super-charger" and “Turbocharger”

19. Open/Closed system.

In the EPPR-22 IWG meeting India raised concerns that an open system might create further dilution of the exhaust flow. IMMA provided data showing that the leakage effect is small enough to be able to be considered negligible in an open system. Therefore, in order to minimise the risk to create extra dilution and reach consensus, the IWG agreed to include both open and closed type (CFV type CVS system) in UN GTR2, with indication that it is up to the Approval Authority whether to accept or not the open type CFV-CVS system for the test, based on data and demonstration by the manufacturer that the leakage can be considered negligible.

20. Extraordinary Characteristics.

It was agreed to keep the note on Extraordinary Characteristics, because in the EU Regulation is applicable for special vehicles.

21. Test room humidity.

A long and difficult discussion took place on whether it was the need to define the humidity range within which a test can be considered valid. It is known the importance of considering the humidity of either the air in the test cell or the intake air of the engine for the correct calculation of the final NOx emission factors. UN Regulation 83 indicates that the humidity in the test cell has to be within $5.5 \leq Ha \leq 12.2$ (g H₂O/kg dry air) for the test to be considered valid. IMMA argued that this imposed on some manufacturers an excess burden as in many regions that range of humidity was not easily achievable without having a conditioned test cell with the corresponding cost. It was noted that the correction factors originated from empirical data of the seventies, on engines without any after-treatment system. The regression analysis included empirical data from 2.85 to 17.2 g H₂O/kg dry air. It should thus be investigated whether these correction factors were still valid nowadays for engines having after-treatment technology. Finally, an agreement by the Contracting Parties was reached by not declaring a test void if performed outside the above range but it requests to apply appropriate correction factors. Further investigation by the Contracting Parties on the validity of the correction factors is encourage in order to extend this humidity range also to two-wheeled vehicles. The final test in the UN GTR 2 reflects these agreements by the following text: “The absolute humidity (Ha) of either the air in the test cell or the intake air of the engine shall be measured, recorded and correction factors for NOx shall be applied.”

22. HC applicable correction factors.

The IWG decided not to add any HC correction factors to the formula for calculating the corrected concentration of Hydrocarbon in the type II idle

test, since ISO has not defined any applicable formula about this matter and no Contracting Party could find HC factors despite all the efforts made.

23. CO₂ tolerance (Test type VII, energy efficiency).

The IWG has discussed on the difference between the CO₂ declared by the manufacturer and that measured by the Approval Authority could be in order to keep the measured value declared by the manufacturer within +4%. While the European Commission proposed to keep the values given in the European Regulation; i.e. +4%, because it is not a tolerance in the measurements, but a given excess for the declaration, India was of the opinion that the difference needs to be based on real data submitted by India EPPR-24-05, which reflects values from specific vehicle categories of Class 1, 2 and 3. India would have preferred policy aligned with real-world data. However, the final consensus was to retain the values given in the European regulation (i.e. +4%)

24. Reference mass, m_{ref} .

The IWG revised the different equations where either m_{ref} (reference mass of the vehicle) and m_k (unladen mass of the vehicle) appears. It was decided to use m_{ref} rather than $m_k + 75$ kg when appropriate.