Submitted by the IWG on WLTP

Informal document **GRPE-76-06-Rev.1**
76th GRPE, 8-12 January 2018,
agenda item 3(b)

Proposal for the technical report on the development of Amendment 1 to global technical regulation No. 19 on Evaporative emission test procedure for the Worldwide harmonised Light vehicles Test Procedure (WLTP)

<Revision to GRPE-76-06, Revised on 11th January 2018>

Technical report on the development of Amendment 1 to global technical regulation No. 19 on Evaporative emission test procedure for the Worldwide harmonised Light vehicles Test Procedure (WLTP)

I. Introduction

1. In the seventy-fourth session of GRPE in January 2017 the WLTP EVAP Task Force submitted a working document and an informal document for the consideration of GRPE.

2. The working document ECE/TRANS/WP.29/GRPE/2017/3 (Proposal for a new global technical regulation on Evaporative emission test procedure for the Worldwide harmonized Light vehicles Test Procedure), GTR 19, contained the new proposed test procedure to measure evaporative emission from non-sealed fuel tank systems.

3. Non-sealed fuel tank systems are mostly used in conventional vehicles with an internal combustion engine. Since these vehicles have a high chance of purging the fuel vapours inside the fuel tank systems and the canister(s) into the internal combustion engines, the pressure inside the fuel tank generated by fuel vapours is well maintained at low level.

4. From late 2016 to September 2017, thirteen meetings (including three face-to-face meetings and two drafting meetings) were held and the WLTP EVAP task force worked to include also a test procedure covering the sealed fuel tank systems in GTR 19. These systems are expected to be used in the hybrid electric vehicles driven mainly by electric motors and in the future conventional vehicles.

5. GTR 19 Amendment 1 complements GTR 19 not only by adding descriptions of the test procedure for sealed fuel tank systems but other concerns related to non-sealed fuel tank systems which were raised along the discussions on sealed fuel tank systems.

6. The discussions of GTR 19 Amendment 1 were led by Mayumi "Sophie" Morimoto (Japan) and Giorgio Martini (JRC). The drafting of the text was led by Serge Dubuc on behalf of the European Commission.

II. Sealed fuel tank systems - Test procedure development

A. Objectives

7. During parking events, the fuel temperature in the fuel tank system increases due to rising ambient temperature and solar radiation. As a result of the increased temperature and consequent evaporation of the fuel, as well as expansion of the air/fuel vapour mixture, the pressure inside the fuel tank system increases significantly. This may lead the evaporation of the lightest petroleum fractions with a corresponding increase of the pressure inside the fuel tank system. In non-sealed fuel tank systems, which are mostly used in conventional vehicles, the increase of the pressure inside the system is limited by the high probability of purging vapours inside the fuel tank system, and the pressure is vented mainly to the canister(s). The canister adsorbs and stores hydrocarbons (HC). However, this canister has a limited adsorbing capacity (depending on several factors of which the most important are the carbon quality, mass, and fuel specification as well as the ambient temperature) and must be periodically purged to desorb the stored hydrocarbons. This occurs during vehicle driving events since part of the combustion air flows through the

canister removing the adsorbed hydrocarbons which are then burned inside the engine.

8. Due to the potentially limited operation time of the combustion engine in hybrid electric vehicles, the use of sealed fuel tank systems is one of the alternative solutions to the system described above to control evaporative emissions. A sealed fuel tank system is by design a closed system that can store fuel vapours inside the system up to the fuel tank relief pressure. In this case, no fuel vapour is vented to the canister nor to the atmosphere. However, the sealed fuel tank systems must be depressurised. This depressurisation is generally achieved by opening a pressure relief valve before refuelling to ensure a safe operation. The mixture of air and vapours released through the pressure relief valve are stored in the canister(s) which are then purged when the combustion engine runs.

9. In the case of very hot temperature conditions, the pressure inside the fuel tank system might exceed the fuel tank relief pressure which is designed to avoid the risk of a rupture of the sealed fuel tank system.

10 A technological option to limit the pressure increase inside the sealed fuel tank system due to a rising ambient temperature is insulating the tank itself. This means that the temperature of the fuel will remain lower than the ambient temperature. This option has been taken into account when developing the test procedure.

B. Approach

11. The following points were discussed during WLTP EVAP task force meetings:

- Discussion points related to sealed fuel tank system test procedure
    - Definitions and abbreviations
    - Test sequence –one continuous test or two separate tests (stand-alone puff loss test, and stand-alone hot soak loss and 48-hour diurnal test)
    - Fuel tank relief pressure requirement for sealed fuel tank system
    - Condition before puff loss loading to canister –soak temperature, soak duration, and pressure inside the fuel tank system after depressurisation
    - Overflow puff loss emissions check after depressurisation
    - Condition of diurnal breathing loss test for sealed fuel tank system
    - Soak temperature
- Discussion points related to improvement of latest GTR 19
    - Vehicle preparation –baking of tyres
    - Type approval authority witness
    - BWC measurement

C. Improvements in the GTR

1. Sealed fuel tank system test procedure

1.1. Definitions and abbreviations

12. Definitions of "*NOVC-HEV*", "*HEV*" and "*HV*" were added by copying and pasting from GTR 15.

13. Definition of "*Monolayer tank*" was updated and the term was renamed to "*Monolayer non-metal tank*".

14. Definition of "*Sealed fuel tank system*" was updated. Whether to include "*Semi-sealed fuel tank system*" which might release the vapours and the pressure from system on first day of diurnal phase but the pressure relief valve would not open for subsequent days was discussed. Since we did not have enough data, the task force decided to discuss it at the next stage.

15. Definition of "*Evaporative emissions*" was updated to include hydrocarbon vapours lost from the fuel system immediately before refuelling of a sealed fuel tank.

16. Definitions of "*Depressurisation puff loss*", "*Depressurisation puff loss overflow*", "*Fuel tank relief pressure*" and "*Auxiliary canister*" were newly added since these terms are related to sealed fuel tank system test procedure.

17. Definition of "*2 gram breakthrough*" was newly added to improve GTR 19.

18. The abbreviation for rechargeable electric energy storage system was newly added since this term is related to the sealed fuel tank system test procedure.

19. Some terms in definitions and abbreviations were decapitalised for drafting purpose.

1.2. Test sequence –one continuous test or two separate tests (stand-alone puff loss test, and stand-alone hot soak loss and 48-hour diurnal test)

20. The test procedure of sealed fuel tank systems consists of two parts. One is the determination of the volume of the depressurisation puff loss loaded to the canister immediately before refuelling and its overflow from the canister. The other is the stand-alone hot soak loss and 48-hour diurnal test, which are the same as for non-sealed fuel tank system.

21. A 2g breakthrough loading of the non-sealed tank system was replaced by the depressurisation puff loss loading volume for subsequent procedures which are the hot soak loss test and the 48-hour diurnal test.

22. Japan proposed to set separate test sequences to improve testing efficiency. On the other hand, some vehicle manufacturers indicated there are some systems which cannot separate canister(s) from system, and this requires a continuous one test sequence. With consideration of those systems, the task force decided to have both one continuous test procedure and two separate tests.

1.3. Fuel tank relief pressure requirement for sealed fuel tank system

23. JRC proposed to set a minimum requirement for fuel tank relief pressure. This proposal was based on concerns for vehicles which would pass the type approval test but might emit significant amount of vapours when the temperature rises above 35°C in the market. Some vehicle manufacturers and Japan opposed this proposal since this proposal may eliminate the possibility of new technologies such as insulated fuel tank systems. To solve the concerns of both, the task force determined to have 2 conditions for the temperature profile during the 48-hour diurnal test, one for systems with a fuel tank relief pressure equal to or higher than 30kPa and another for those below 30kPa. This would provide manufacturers with the scope to develop systems which incorporate a wider range of new technologies.

24. The value of the fuel tank relief pressure to determine the condition of preparation was decided based on the study result provided by task force members. Their study was based on maximum monthly temperature of Rome, New Delhi and Kyoto. The study also included the estimation of the fuel tank pressure based on market fuel properties under the temperature condition of those cities. The task force decided to set 30kPa as a threshold by considering +5°C margin from maximum temperature.

1.4. Condition before puff loss loading to canister –soak temperature, soak duration, and pressure inside the fuel tank system after depressurisation

25. The soak temperature profile before puff loss loading to the canister was decided based on the 24-hour diurnal breathing loss test (DBL). After 11 hours, the temperature inside the soak room will reach to the maximum during the DBL profile. Therefore, the task force decided to use 11 hours as soak duration.

26. The pressure inside the system after depressurisation was decided as maximum 2.5 kPa above ambient pressure in normal vehicle operation and use. This is based on the pressure requirement inside the fuel tank system during run loss test of US EPA.

1.5. Overflow puff loss emissions check after depressurisation

27. Immediately before refuelling, the sealed fuel tank system will be depressurised before the fuel cap is opened. When depressurised, the pressure will be relieved to atmosphere through the canister. To avoid unexpected escape of vapours with those pressures, Japan proposed to include a check of overflow vapours from the canister during the sealed fuel tank system test procedure. After extensive discussions, the task force supported the proposal.

1.6. Condition of diurnal breathing loss test for sealed fuel tank system

28. As explained in paragraph 1.3., the task force decided to have two conditions for the temperature profile during the 48-hour diurnal test depending on the fuel tank relief pressure. The systems with fuel tank relief pressure equal to or higher than 30kPa will use a 20 to 35°C temperature profile, the same as a non-sealed fuel tank system. On the other hand, the system with a pressure lower than 30kPa should have a 20 to 38°C profile. This profile was decided based on estimated pressure of sealed fuel tank system at +5°C margin maximum temperature.

1.7. Soak temperature

29. Within GTR 19 there are two different types of soak which are undertaken at different temperatures. The soak which occurs before the dynamometer test should be carried at 23°C, because dynamometer test is also undertaken at 23°C. The soak that takes place prior to the following sequences are carried out at 20°C because these sequences start from 20°C.

(a) the diurnal test (for both non-sealed fuel tank system and sealed fuel tank system test procedures)
(b) the conditioning for puff loss loading (for sealed fuel tank system test procedure only)
(c) fuel tank depressurisation (for sealed fuel tank system test procedure only)

30. However, there exists one exemption in the sealed fuel tank system test procedure. This is where the dynamometer test starts after soaking at 20°C (paragraph 6.6.1.12. followed by paragraph 6.5.6. of Annex 1 of GTR 19 Amendment 1). After intensive discussion within TF members, they decided to skip another soak at 23°C because it would cause a burden to soak again for at least another 6 hours.

2. Discussion points related to improvement of latest GTR 19

2.1 Vehicle preparation –baking of tyres

31. During 74th GRPE, ETRMA (European Tyre & Rubber Manufacturers' Association) requested to clarify the baking temperature of tyres. Task force members studied many documents to set the appropriate temperature. Finally, the temperature of baking tyres was decided based on the description of "bake" in US Tier 3 preamble, which was 50 °C or higher.

2.2 Type approval authority witness

32. During 74th GRPE, CITA (International Motor Vehicle Inspection Committee) pointed out that the description in paragraph 5.3.11. of Annex 1 of GTR 19 "The manufacturer shall provide the responsible authority a test report" might be misleading and could be interpreted to mean that there is no chance of witness of evaporative emission test. Also at 19th WLTP IWG, UTAC pointed out that there might need a clearer description of an audit or a witness test.

33. With much discussion between authority and industry members, paragraph 5.3.11. of Annex 1 of GTR 19 (paragraph 8. of Annex 1 of GTR 19 Amendment 1) was changed to delete the description pointed out by CITA. The description of an audit or a witness test raised by UTAC was decided not to be written in detail since how this should be done depends on each Contracting Party.

2.3 BWC measurement

34. Japan raised the concern that a result from measurement of BWC50 will never be used or submitted to an authority. After discussion within task force members, measurement of BWC50 was deleted from the test procedure. However, BWC300 measurement, which is used to decide evaporative emission family, remains and shall be done before certification test according to the procedure written in GTR 19 Amendment 1.