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### World Forum for Harmonization of Vehicle Regulations

### Working Party on Pollution and Energy

#### Seventy-third session

Geneva, 7-10 June 2016

## Report of the Working Party on Pollution and Energy (GRPE) on its seventy-third session

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## **I. Attendance and opening statements**

1. The Working Party on Pollution and Energy (GRPE) held its seventy-third session from 7 to 10 June 2016, with Mrs. R. Urdhwareshe (India) as Chair. Experts from the following countries participated in the work following Rule 1(a) of the Rules of Procedure of the World Forum for Harmonization of Vehicle Regulations (WP.29) (TRANS/WP.29/690, as amended): Belgium; Canada; China; Czech Republic; France; Germany; Hungary; India; Italy; Japan; Netherlands; Norway; Poland; Republic of Korea (Korea); Romania; Russian Federation; Spain; Sweden; Switzerland; United Kingdom of Great Britain and Northern Ireland (UK) and the United States of America. Experts from the European Commission (EC) also participated. Experts from the following non-governmental organizations took part in the session: Association for Emissions Control by Catalyst (AECC); European Association of Automobile Suppliers (CLEPA/MEMA/JAPIA); European Federation for Transport and Environment (T&E); European Garage Equipment Association (EGEA); European Liquefied Petroleum Gas Association (AEGPL); European Natural Gas Vehicle Association (NGVA Europe); International Association for Natural Gas Vehicles (IANGV/NGV Global); International Motorcycle Manufacturers Association (IMMA); International Organization of Motor Vehicle Manufacturers (OICA); Technical Committee of Petroleum Additive Manufacturers in Europe (CEFIC-ATC) and The European Association of Internal Combustion Engine Manufacturers (EUROMOT).

2. The secretary informed GRPE that the Vice-Chair, Mrs. R. Urdhwareshe (India), would be chairing the session in the absence of the GRPE Chair, Mr. C. Albus (Germany).

## **II. Adoption of the agenda (agenda item 1)**

*Documentation:* ECE/TRANS/WP.29/GRPE/2016/9 and Add.1  
Informal documents GRPE-73-01, GRPE-73-08 and  
GRPE-73-19-Rev.1

3. GRPE adopted the provisional agenda of its seventy-third session (ECE/TRANS/WP.29/GRPE/2016/9 and Add.1), as updated and consolidated in GRPE-73-19-Rev.1, including the informal documents tabled for the session. GRPE took note of GRPE-73-01 on the organization of GRPE Informal Working Group (IWG) meetings held during the week.

4. The informal documents distributed during the GRPE session are listed in Annex I. Annex II contains a list of the informal meetings held in conjunction with the GRPE session. Annex III lists GRPE IWGs, task forces and subgroups, giving details on their Chairs, secretaries and the end of their mandates.

5. The secretariat introduced GRPE-73-08, announcing that the next GRPE session would take place during 10-13 January 2017 and recalling the corresponding deadline (10 October 2016) for the submission of official documents. The Chairs and Secretaries of IWGs were invited to approach the secretariat to define the calendar of meetings of IWGs for the January 2017 GRPE session.

## **III. Report on the last session of the World Forum for Harmonization of Vehicle Regulations (WP.29) (agenda item 2)**

*Documentation:* ECE/TRANS/WP.29/1120  
Informal document GRPE-73-09

6. The secretariat introduced GRPE-73-09 and reported on relevant GRPE items discussed during the 168<sup>th</sup> session of the World Forum. For more details, see ECE/TRANS/WP.29/1120.

#### **IV. Light vehicles (agenda item 3)**

##### **A. Regulations Nos. 68 (Measurement of the maximum speed, including electric vehicles), 83 (Emissions of M<sub>1</sub> and N<sub>1</sub> vehicles), 101 (CO<sub>2</sub> emissions/fuel consumption) and 103 (Replacement pollution control devices)**

*Documentation:* ECE/TRANS/WP.29/GRPE/2016/10  
ECE/TRANS/WP.29/GRPE/2016/11  
Informal documents GRPE-73-03 and GRPE-73-27

7. The expert from Italy presented ECE/TRANS/WP.29/GRPE/2016/10 to align the requirements of Regulation No. 83 with those of Regulation No. 49 by introducing the possibility to inhibit the driver inducement system of rescue and police service vehicles.

8. The expert from EC introduced ECE/TRANS/WP.29/GRPE/2016/11 aimed at providing clarifications and correcting errors in Regulation No. 83.

9. GRPE adopted ECE/TRANS/WP.29/GRPE/2016/10 and ECE/TRANS/WP.29/GRPE/2016/11 and requested the secretariat to submit them to WP.29 and the Administrative Committee of the 1958 Agreement (AC.1) for consideration and vote at their November 2016 sessions as draft Supplement 8 to the 06 series of amendments and draft Supplement 4 to the 07 series of amendments to Regulation No. 83.

10. The expert from UK presented the report of the vehicle emissions testing programme carried out in his country for the most popular diesel vehicles split between Euro 5 and Euro 6 (GRPE-73-03). He underlined in GRPE-73-27 that emission control devices were significantly temperature dependent and that large differences were observed between laboratory and track results over the New European Driving Cycle (NEDC). He highlighted that both, the Worldwide harmonized Light vehicles Test Procedure (WLTP) and Real Driving Emissions (RDE), were expected to overcome these issues and minimize the possibility to manipulate tests. He mentioned that no evidence had been found that other manufacturers had acted in the same way as Volkswagen.

11. The expert from EC informed GRPE about similar vehicle emissions testing programmes taking place in several European member States. She mentioned that results on the investigation may be available in year 2017.

##### **B. GTR No. 15 on Worldwide harmonized Light vehicles Test Procedure (WLTP)**

*Documentation:* Informal documents GRPE-73-05, GRPE-73-10, GRPE-73-11, GRPE-73-12 and GRPE-73-26

12. The Vice-Chair of the IWG on WLTP reported on the progress made by the group on each of the tasks of the Phase 2 activities (GRPE-73-10). He introduced GRPE-73-11 showing the two steps work plan (Phase 2A and Phase 2B). He referred to GRPE-73-12 as a first draft of the new GTR on evaporative emissions for WLTP.

13. The expert from OICA expressed some comments on the transposition of GTR No. 15 on WLTP into a new Regulation annexed to the 1958 Agreement (GRPE-73-05). He underlined the complexity of this transposition process due to the lack of harmonization in the current version of GTR No. 15 and the difficulty of defining a worst case approach when combining local pollutants and fuel consumption in the same legal framework. He emphasized that GRPE-73-05 did not contain any specific proposal but was rather intended to encourage GRPE to intensify discussion on this relevant topic before moving forward. He recalled the need to take into account the Universal International Whole Vehicle Type Approval (U-IWVTA) and requested the GRPE Ambassador on this topic to actively inform GRPE about plans, timing and consequences of IWVTA.

14. The expert from EC recalled the new European legislation on emissions which will come into force for new vehicles as of September 2017 and will include new provisions on RDE and WLTP. She mentioned that for this purpose, the European Union member States may envisage to cease applying Regulations Nos. 83 and 101 as of September 2017 and, thus, there may be a time gap between the cessation and the establishment of a new Regulation on WLTP. She informed GRPE that the Task Force under the IWG on WLTP dealing with the transposition process would meet for the first time in September 2016.

15. The secretariat presented GRPE-73-26 upon the request of EC to explore possible approaches to transpose WLTP into a new Regulation. The secretariat underlined the complexity to be fully in line with the 1958 Agreement in the transposition process, particularly in a situation where not all Contracting Parties applying that Regulation would accept any of the alternative requirements. The secretariat informed GRPE about a possible way forward, although alerted that it would only be comprehensible under Revision 3 of the 1958 Agreement and it would be subject to the endorsement of the Office of Legal Affairs (OLA) and all Contracting Parties to the 1958 Agreement. The secretariat highlighted that any Contracting Party intending to cease applying a Regulation should notify it at least one year in advance.

16. GRPE noted the urgency to solve the issues related to the transposition of WLTP into a new Regulation and agreed to further discuss it at the next GRPE session on the basis of the work carried out by the Task Force dealing with this topic. GRPE noted the intention of the IWG on WLTP to submit a draft new GTR on evaporative emissions as an official document together with the technical report at the next GRPE session. GRPE acknowledged the progress made by the group and noted the request for a meeting room for one day during the GRPE week in January 2017.

## **V. Heavy duty vehicles (agenda item 4)**

### **A. Regulations Nos. 49 (Emissions of compression ignition and positive ignition (LPG and CNG) engines) and 132 (Retrofit Emissions Control devices (REC))**

17. GRPE did not receive any new proposal to amend Regulations Nos. 49 and 132.

### **B. GTR Nos. 4 (World-wide harmonized Heavy Duty Certification procedure (WHDC)), 5 (World-Wide harmonized Heavy duty On-Board Diagnostic systems (WWH-OBD)) and 10 (Off-Cycle Emissions (OCE))**

18. GRPE did not receive any new proposal to amend GTRs Nos. 4, 5 and 10.

## **VI. Regulations Nos. 85 (Measurement of the net power), 115 (LPG and CNG retrofit systems) and 133 (Recyclability of motor vehicles) (agenda item 5)**

19. GRPE did not receive any new proposal to amend Regulations Nos. 85, 115 and 133.

## **VII. Agricultural and forestry tractors, non-road mobile machinery (agenda item 6)**

### **A. Regulations Nos. 96 (Diesel emission (agricultural tractors)) and 120 (Net power of tractors and non-road mobile machinery)**

*Documentation:* Informal documents GRPE-73-02 and GRPE-73-06

20. The expert from EC informed GRPE about the ongoing work at the European Union on the development of a new regulation on Non-Road Mobile Machinery (NRMM) engines (GRPE-73-06). She highlighted that the new regulation would extend the scope, establish new emission limits and enhance the provisions of Directive 97/68/EC and, thus, Regulation No. 96 should be aligned accordingly. The experts from Italy and UK expressed their support to this activity.

21. Referring to GRPE-73-02, the expert from EUROMOT underlined the importance of aligning Regulation No. 96 and the new European regulation on NRMM. He expressed the readiness of EUROMOT to support this activity. He mentioned that Regulation No. 120 would need to be slightly modified as well to align some specific provisions.

22. GRPE noted the intention of EC to submit a proposal amending Regulation No. 96 in the future and invited other stakeholders to participate in this activity.

### **B. GTR No. 11 (Non-road mobile machinery engines)**

23. GRPE did not receive any new proposal to amend GTR No. 11.

## **VIII. Particle Measurement Programme (PMP) (agenda item 7)**

*Documentation:* Informal documents GRPE-73-13, GRPE-73-14 and GRPE-73-15-Rev.1

24. The Chair of the IWG on PMP presented a status report on the activities of the group on exhaust and non-exhaust particle emissions (GRPE-73-13). He introduced a summary report on the results of the investigation carried out on non-exhaust particle emissions as a result of brake wear and tyre/road interaction (GRPE-73-14). He highlighted the interest shown by different stakeholders on developing a standardized test procedure for sampling and investigating brake wear particles, both in terms of mass and number. He mentioned that different approaches had already been discussed and a commonly accepted test rig configuration with standardized sampling and measurement methodologies appeared to be the best option to be developed. He explained that for tyre and road wear particles the IWG on PMP did not have the necessary expertise and resources to scale up the investigation to properly address the existing knowledge gaps. He presented the revised terms of reference and rules of procedure of the IWG on PMP (GRPE-73-15-Rev.1) which extend the mandate

until June 2019 with two new objectives: (a) perform a Round Robin test to demonstrate the feasibility to measure particles with a size below 23 nanometre by the existing PMP methodology properly modified, and (b) develop a suggested common test procedure for sampling and assessing brake wear particles, both in terms of mass and number.

25. GRPE adopted the updated terms of reference and rules of procedure of the IWG on PMP as reproduced in Annex IV. GRPE acknowledged the work progress of the group and noted the request for a meeting room for half a day during the GRPE week in January 2017.

## **IX. Gaseous Fuelled Vehicles (GFV) (agenda item 8)**

*Documentation:* ECE/TRANS/WP.29/GRPE/2016/12  
Informal documents GRPE-73-04, GRPE-73-07, GRPE-73-28 and GRPE-73-29

26. The Chair of the IWG on GFV introduced ECE/TRANS/WP.29/GRPE/2016/12 on a draft new Regulation on Heavy Duty Dual-Fuel Engine Retrofit Systems (HDDF-ERS) to be installed in heavy duty diesel engines that had been approved according to Regulation No. 49. He presented GRPE-73-04 on corrections and clarifications to be inserted in ECE/TRANS/WP.29/GRPE/2016/12. He explained the main provisions of the Regulation and the changes introduced since January 2016 (GRPE-73-28). He underlined that the working principle had always been that the pollutant emissions of a retrofitted dual-fuel engine shall be lower than or at the most equal to those of the original diesel engine. He recalled that the mandate of the IWG on GFV expired in June 2016 and that the group had finalized its work in due time by submitting the draft new Regulation on HDDF-ERS. He presented GRPE-73-29 listing all the achievements of the IWG on GFV as of year 2008.

27. The experts from Switzerland, EC, NGVA Europe and NGV Global expressed their support to ECE/TRANS/WP.29/GRPE/2016/12. The expert from NGVA Europe expressed the readiness of the industry, original equipment manufacturers as well as retrofitters to adopt the proposed new Regulation. Based on the ongoing research, he mentioned that the Regulation could be improved at a later stage by making its structure less demanding.

28. The expert from AEGPL introduced GRPE-73-07 proposing that the requirements for carbon monoxide (CO) and non-methane hydrocarbons (NMHC) emissions of retrofitted dual-fuel engines should be made less stringent by allowing a factor of two in comparison with original diesel engine emissions. He proposed to postpone the adoption of ECE/TRANS/WP.29/GRPE/2016/12 to be able to reach an agreement. The expert from Italy suggested to adopt the proposal but submit it to WP.29 and AC.1 at their March 2017 sessions so that additional time would be given to further discuss this topic at GRPE.

29. Following the discussion, GRPE adopted ECE/TRANS/WP.29/GRPE/2016/12 as amended by Annex V of this report and requested the secretariat to submit it to WP.29 and AC.1 for consideration and vote at their November 2016 sessions as draft new Regulation on uniform provisions concerning the approval of HDDF-ERS to be installed on heavy duty diesel engines and vehicles. GRPE acknowledged the achievements of the IWG on GFV since it was established in 2008 and requested the secretariat to delete this agenda item from the next session.

## **X. Motorcycles and mopeds (agenda item 9)**

### **A. Regulations Nos. 40 (Emission of gaseous pollutants by motor cycles) and 47 (Emission of gaseous pollutants of mopeds)**

30. GRPE did not receive any new proposal to amend Regulations Nos. 40 and 47.

## **B. Environmental and Propulsion Performance Requirements (EPPR) for L-category vehicles**

*Documentation:* ECE/TRANS/WP.29/GRPE/2016/13  
Informal documents GRPE-73-16, GRPE-73-17, GRPE-73-18-Rev.1, GRPE-73-20 and GRPE-73-21

31. The Chair of the IWG on EPPR presented a status report (GRPE-73-20) on the activities of the group. He presented ECE/TRANS/WP.29/GRPE/2016/13 on a draft new GTR on the measurement procedure for two- or three-wheeled motor vehicles with regard to on-board diagnostics. He explained the main issues addressed by the group on the applicability, scope and requirements of the draft new GTR (GRPE-73-21). He introduced GRPE-73-16 on modifications to ECE/TRANS/WP.29/GRPE/2016/13 and he referred to GRPE-73-17 as a consolidated version of both documents. He introduced the technical report on the development of the draft new GTR (GRPE-73-18-Rev.1). He announced that the next priority of the IWG on EPPR would be to initiate the work on amendments to GTR No. 2.

32. GRPE adopted ECE/TRANS/WP.29/GRPE/2016/13 as amended by Annex VI of this report and requested the secretariat to submit it to WP.29 and the Executive Committee of the 1998 Agreement (AC.3) for consideration and vote at their November 2016 sessions as a draft new GTR on the measurement procedure for two- or three-wheeled motor vehicles with regard to on-board diagnostics. GRPE also adopted the technical report (GRPE-73-18-Rev.1) as reproduced in Annex VII of this report and requested the secretariat to submit it to WP.29 and AC.3 for consideration and vote at their November 2016 sessions. GRPE noted the intention of the IWG on EPPR to submit a proposal on amendments to GTR No. 2 in the year 2017. GRPE acknowledged the progress made by the group and noted the request for a meeting room for one day during the GRPE week in January 2017.

## **C. GTR No. 2 (World-wide Motorcycle emissions Test Cycle (WMTC))**

33. GRPE did not receive any new proposal to amend GTR No. 2.

## **XI. Electric Vehicles and the Environment (EVE) (agenda item 10)**

*Documentation:* Informal documents GRPE-73-23 and GRPE-73-24

34. The Chair of the IWG on EVE presented a status report on the ongoing activities of the group (GRPE-73-23). He presented a draft report on the results of part A of the mandate on data and information gathering (GRPE-73-24). He mentioned that an updated version of this report was expected to be submitted to the next GRPE session. He explained the options and recommendations on the way forward for part B of the mandate under each of the areas of work: (a) recyclability was expected to be removed from any subsequent mandate; (b) the activities on a method of stating energy consumption may conclude with the model already developed or may continue to refine the model; (c) research on battery durability may continue or development of a new GTR may be initiated; and (d) development of a procedure for the power-train performance determination was expected to be recommended as part of GTR No. 15.



35. GRPE noted that the IWG on EVE will meet in July 2016 with the aim at a final consensus and may then submit a request for the development of GTRs at the AC.3 November 2016 session to start immediately Part B activities. GRPE acknowledged the progress made by the IWG on EVE and noted the request for a meeting room for half a day during the GRPE week in January 2017.

## **XII. Mutual Resolution No. 2 (M.R.2) (agenda item 11)**

36. GRPE did not receive any new proposal to amend M.R.2.

## **XIII. International Whole Vehicle Type Approval (IWVTA) (agenda item 12)**

*Documentation:* Informal document GRPE-73-22

37. The GRPE Ambassador presented GRPE-73-22 on the timing and activities of the IWG on IWVTA. He indicated the new concept of attestation as a possible solution for the transposition of WLTP into a new Regulation usable for U-IWVTA.

## **XIV. Vehicles Interior Air Quality (VIAQ) (agenda item 13)**

*Documentation:* Informal document GRPE-73-25

38. The Chair of the IWG on VIAQ reported on the ongoing activities on collecting information and reviewing existing standards to develop recommendations to harmonize test procedures of interior air emissions generated from interior materials (GRPE-73-25). He expressed the intention of the IWG to submit a first draft of recommendations on VIAQ as a new Mutual Resolution at the next GRPE session.

39. GRPE acknowledged the progress made by the IWG on VIAQ and noted the request for a meeting room for half a day during the GRPE week in January 2017.

## **XV. Exchange of information on emission requirements (agenda item 14)**

40. GRPE did not receive any information for this item.

## **XVI. Election of officers (agenda item 15)**

41. The secretariat informed GRPE about the absence of candidates for the GRPE chairmanship in the year 2017. The election of officers was postponed to the next GRPE session in January 2017. The secretariat encouraged GRPE participants to present their candidatures for the GRPE chairmanship and vice-chairmanship in the year 2017 and to inform the secretariat as soon as possible.

## **XVII. Any other business (agenda item 16)**

42. On behalf of GRPE, the Chair of GRPE paid tribute to Mr. K. Narusawa (Japan) and Mr. P. Laurent (CLEPA), who would no longer be attending GRPE sessions, and acknowledged their considerable contributions to the activities of GRPE.

## **XVIII. Provisional agenda for the next session**

### **A. Next GRPE session**

43. The next GRPE session, including the IWG meetings, is scheduled to be held in Geneva, Palais des Nations, starting on Monday, 9 January 2017, from 9.30 a.m. until Friday, 13 January 2017, at 12.30 p.m., subject to confirmation by the secretariat (see GRPE-74-01, forthcoming). Interpretation would be provided from 10 January (2.30 p.m.) to 13 January (12.30 p.m.) 2017.

### **B. Provisional agenda for the next proper GRPE session**

44. GRPE agreed on the following provisional agenda for its next session:

1. Adoption of the agenda.
2. Report on the last sessions of the World Forum for Harmonization of Vehicle Regulations (WP.29).
3. Light vehicles:
  - (a) Regulations Nos. 68 (Measurement of the maximum speed, including electric vehicles), 83 (Emissions of M<sub>1</sub> and N<sub>1</sub> vehicles), 101 (CO<sub>2</sub> emissions/fuel consumption) and 103 (Replacement pollution control devices);
  - (b) Global technical regulation No. 15 on Worldwide harmonized Light vehicles Test Procedures (WLTP).
4. Heavy duty vehicles:
  - (a) Regulations Nos. 49 (Emissions of compression ignition and positive ignition (LPG and CNG) engines) and 132 (Retrofit Emissions Control devices (REC));
  - (b) Global technical regulations Nos. 4 (World-wide harmonized Heavy duty Certification procedure (WHDC)), 5 (World-Wide harmonized Heavy duty On-Board Diagnostic systems (WWH-OBD)) and 10 (Off-Cycle Emissions (OCE)).
5. Regulations Nos. 85 (Measurement of the net power), 115 (LPG and CNG retrofit systems) and 133 (Recyclability of motor vehicles).
6. Agricultural and forestry tractors, non-road mobile machinery:
  - (a) Regulations Nos. 96 (Diesel emission (agricultural tractors)) and 120 (Net power of tractors and non-road mobile machinery);
  - (b) Global technical regulation No. 11 (Non-road mobile machinery engines).
7. Particle Measurement Programme (PMP).
8. Motorcycles and mopeds:
  - (a) Regulations Nos. 40 (Emission of gaseous pollutants by motor cycles) and 47 (Emission of gaseous pollutants of mopeds);
  - (b) Environmental and Propulsion Performance Requirements (EPPR) for L-category vehicles;

- (c) Global technical regulation No. 2 (World-wide Motorcycle emissions Test Cycle (WMTC)).
9. Electric Vehicles and the Environment (EVE).
  10. Mutual Resolution No. 2 (M.R.2).
  11. International Whole Vehicle Type Approval (IWVTA).
  12. Vehicles Interior Air Quality (VIAQ).
  13. Exchange of information on emission requirements.
  14. Election of officers.
  15. Any other business.

**C. Informal meetings scheduled to be held in conjunction with the next GRPE session**

45. The informal meetings were scheduled to be held as follows, subject to confirmation:

<i>Date</i>	<i>Group</i>	<i>Acronym</i>	<i>Time</i>
Monday, 9 January 2017	Environmental and Propulsion Performance Requirements of L-category vehicles	EPPR	9.30 a.m. – 12.30 p.m. 2.30 p.m. – 5.30 p.m.
Tuesday, 10 January 2017	Worldwide harmonized Light vehicles Test Procedure	WLTP	9.30 a.m. – 12.30 p.m. 2.30 p.m. – 5.30 p.m.
	Vehicle Interior Air Quality	VIAQ	9.30 a.m. – 12.30 p.m.
Wednesday, 11 January 2017	Particle Measurement Programme	PMP	2.30 p.m. – 5.30 p.m.
	Electric Vehicles and the Environment	EVE	2.30 p.m. – 5.30 p.m.

46. The agendas of these meetings will be prepared by the respective secretaries and distributed to the members of each group prior to each meeting.

## Annex I

## List of informal documents distributed without an official symbol

<i>GRPE-73-</i>	<i>Transmitted by</i>	<i>Title</i>	<i>Follow-up</i>
1	Secretariat	Informal meetings in conjunction with the GRPE (proper) session: schedule and rooms	A
2	EUROMOT	Alignment of Regulation No. 96 to EU Stage V	A
3	UK	Vehicle Emissions Testing Programme	A
4	GFV	Proposal for amendments to ECE/TRANS/WP.29/GRPE/2016/12 on a new Regulation on Heavy Duty Dual-Fuel Engine Retrofit Systems (HDDF-ERS)	B
5	OICA	Comments on the transposition process of GTR No. 15 (WLTP) into UN Regulation (1958 Agreement)	A
6	EC	A new EU Regulation for engines in Non-Road Mobile Machinery (NRMM)	A
7	AEGPL	Proposal for amendments to ECE/TRANS/WP.29/GRPE/2016/12 on a new Regulation on Heavy Duty Dual-Fuel Engine Retrofit Systems (HDDF-ERS)	A
8	Secretariat	General information	A
9	Secretariat	Highlights of the last WP.29 session (March 2016)	A
10	WLTP	Status report	A
11	WLTP	WLTP Phase 2 working items and schedule	A
12	WLTP	Draft gtr on evaporative emission test procedure	A
13	PMP	Status report	A
14	PMP	Summary report on non-exhaust traffic related particle emissions (brake and tyre/road wear)	A
15- Rev.1	PMP	Terms of reference and rules of procedure for the Informal Working Group on the Particle Measurement Programme	B
16	EPPR	Proposal for amendments to ECE/TRANS/WP.29/GRPE/2016/13 on a new gtr on the measurement procedure for two- or three-wheeled motor vehicles with regard to on-board diagnostics (track changes)	B
17	EPPR	Proposal for amendments to ECE/TRANS/WP.29/GRPE/2016/13 on a new gtr on the measurement procedure for two- or three-wheeled motor vehicles with regard to on-board diagnostics (consolidated version)	A
18- Rev.1	EPPR	Technical report on the development of a new gtr on the measurement procedure for two- or three-wheeled motor vehicles with regard to on-board diagnostics	B
19- Rev.1	Secretariat	Updated provisional agenda (including all informal documents)	A
20	EPPR	Status report	A
21	EPPR	Proposal for a new gtr on the measurement procedure for two- or three-wheeled motor vehicles with regard to on-board diagnostics	A
22	GRPE Ambassador	Report by the GRPE Ambassador on IWTA	A
23	EVE	Status report	A
24	EVE	Status report of part A of the mandate	A
25	VIAQ	Status report	A
26	Secretariat	Comments on the transposition process of GTR No. 15 (WLTP) into UN Regulation (1958 Agreement)	A

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<i>GRPE-73-</i>	<i>Transmitted by</i>	<i>Title</i>	<i>Follow-up</i>
27	UK	Summary of the Vehicle Emissions Testing Programme	A
28	GFV	Status report	A
29	GFV	Accomplishments	A

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*Notes:*

- A Consideration by GRPE completed or to be superseded.
- B Adopted and submitted to WP.29.

## Annex II

### Informal meetings held in conjunction with the GRPE session

<i>Date</i>	<i>Time</i>	<i>Group</i>	<i>Acronym</i>
6 June 2016	9:30 a.m. - 12:30 p.m.	Environmental and Propulsion Performance Requirements of L-category vehicles	EPPR
	2:30 p.m. - 5:30 p.m.	Environmental and Propulsion Performance Requirements of L-category vehicles	EPPR
7 June 2016	9:30 a.m. - 12:30 p.m.	Worldwide harmonized Light vehicles Test Procedure	WLTP
	2:30 p.m. - 5:30 p.m.	Worldwide harmonized Light vehicles Test Procedure	WLTP
8 June 2016	9:30 a.m. - 12:30 p.m.	Vehicle Interior Air Quality	VIAQ
	2:30 p.m. - 5:30 p.m.	Gaseous Fuelled Vehicles	GFV
	2:30 p.m. - 5:30 p.m.	Electric Vehicles and the Environment	EVE

## Annex III

### List of GRPE informal working groups, task forces and subgroups

<i>Name (Acronym) (Status)</i>	<i>Chair or Co-chairs</i>	<i>Secretaries</i>	<i>End of mandate</i>
Environmental and Propulsion Performance Requirements of L-category vehicles (EPPR) (group)	Adolfo Perujo, Adolfo.PERUJO@ec.europa.eu	Daniela Leveratto, d.leveratto@immamotorcycles.org  Hardik Makhija, hardik@siam.in	December 2020
Electric Vehicles and the Environment (EVE) (group)	Michael Olechiw, Olechiw.Michael@epamail.epa.gov  Chen Chunmei (vice-Chair), chencm@miit.gov.cn  Kazuyuki Narusawa (vice-Chair), narusawa@ntsel.go.jp	Andrew Giallonardo, Andrew.Giallonardo@ec.gc.ca	November 2018
Gaseous Fuelled Vehicles (GFV) (group)	André Rijnders, arijnders@rdw.nl	Jeffrey Seisler, jseisler@cleanfuelsconsulting.org  Salvatore Piccolo, s.piccolo@federchimica.it	June 2016
Heavy Duty Dual-Fuel Task Force (HDDV TF) (task force)	Henk Dekker, henk.j.dekker@tno.nl	Jeffrey Seisler, jseisler@cleanfuelsconsulting.org	
Liquefied Natural Gas Task Force (LNG TF) (task force)	Paul Dijkhof, Paul.Dijkhof@kiwa.nl	Jeffrey Seisler, jseisler@cleanfuelsconsulting.org  Jaime Del Alamo, jaime.alamo@ngvaeurope.eu	
Particle Measurement Programme (PMP) (group)	Giorgio Martini, giorgio.martini@jrc.ec.europa.eu	Caroline Hosier, chosier@ford.com	June 2019
Vehicle Interior Air Quality (VIAQ) (group)	Jong Soon Lim, jongsoon@ts2020.kr Yunshan GE (vice-Chair), geyunshan@163.com	Andreas Wehrmeier, andreas.wehrmeier@bmw.de	November 2017
Worldwide harmonized Light vehicles Test Procedure (WLTP) – Phase 2 (group)	Stephan Redmann (to be confirmed), stephan.redmann@bmvbs.bund.de Daisuke Kawano (vice-Chair), kawano@ntsel.go.jp	Noriyuki Ichikawa (co-Technical Secretary), noriyuki_ichikawa@mail.toyota.co.jp Markus Bergmann (co-Technical Secretary), markus.bergmann@audi.de	December 2019

## Annex IV

### Updated terms of reference and rules of procedure of the IWG on PMP

Adopted on the basis of GRPE-73-15-Rev.1 (see para. 25)

#### 1. Background

- 1.1. Since the inception of the Informal Working Group (IWG) on Particle Measurement Programme (PMP), the activities focused on development of an alternative metric with increased sensitivity compared to the existing Particulate Matter (PM) mass measurement system for Heavy Duty (HD) and Light Duty (LD) engines/vehicles (M and N category vehicles) were continued.
- 1.2. This phase concluded with the development and adoption into Regulations Nos. 83 (emissions of  $M_1$  and  $N_1$  vehicles) (R83) and 49 (emissions of compression ignition and positive ignition (LPG and CNG) engines) (R49) of a Particle Number (PN) counting method for ultrafine solid particles, together with enhancements to the PM measurement procedure for R83. Initially the PN protocol was applied for diesel engines/vehicles only in the 06 series of amendments of R83 (R83.06) and R49 (R49.06) and subsequently has been extended to cover vehicles using spark ignition direct injection engines in R83.06.
- 1.3. The European Union (EU) and Switzerland requested in 2013 further investigation of particle number emissions from spark ignition engines relating to particle size (reduction of the 50 per cent counting efficiency specification  $d_{50}$ ) and to emissions under rich operation conditions. As follow-up of this request, the PMP IWG has monitored particle emissions from a large variety of LD engine technologies. The attention has been mainly focused on the difference between the number of particles measured with the existing PMP methodology ( $d_{50}=23$  nm) and with systems with lower  $d_{50}$ s. The fraction of particles emitted by the monitored engines not captured/counted by the existing PMP methodology is extremely variable and it depends very much on the engine technology and on the  $d_{50}$  considered. However, the  $d_{50}=23$  nm seems not to be a major issue as far as current engine technologies to which the PN limit is applicable are concerned (i.e. diesel and G-DI), since high emitters are still unequivocally detected. Therefore it appears that there is no urgent need to modify the  $d_{50}$  to lower values. Moreover, the PMP IWG also concluded that in any case it would be extremely challenging, especially for the very high uncertainty, to develop a reliable particle counting methodology with a  $d_{50}$  well below 10 nm. It is foreseeable that the PN measuring uncertainty is worsened and instrument specific differences will increase compared to the existing method. Further activity to investigate the possibility to modify the existing PMP methodology  $d_{50}$  from 23 to about 10 nm is still considered useful in order to cover potential future needs.
- 1.4. It was also requested to consider whether there is a need to extend particle measurement procedures to additional sources such as brake wear and the interaction between tyres and road. The first step consisted of a literature survey having the objective of summarizing the current knowledge on the physical/chemical nature, mass, number and size distribution of non-exhaust particle emissions. One of the main issues identified during the literature survey is the large variety of methodologies and test conditions used in the published studies. This may explain why often these studies lead to very different or even contradicting conclusions. The



IWG therefore agreed that a suggested common test procedure for sampling and investigating brake wear particles would be beneficial for future research purposes as well as for the development of low emitting brake systems. On the other hand, measuring particle emissions generated by the interaction between tyres and road is much more challenging, due to the difficulty of distinguishing the contributions from tyres, material deposited on the road and the road itself. Nevertheless the IWG proposes to continue monitoring all information relevant to tyre/road wear particles.

## **2. Terms of reference**

- 2.1. The IWG should prepare the update and integration of test procedure updates into Regulations Nos. 83, 49 and 96 (diesel emission (agricultural tractors)) as appropriate.
- 2.2. The IWG may consider, at a later stage, the transposition of the developed procedures into the Global Technical Regulations (GTR) Nos. 4 (Worldwide Harmonized Heavy Duty Certification procedure (WHDC)) and 15 (Worldwide harmonized Light vehicles Test Procedure (WLTP)).

## **3. Timeline**

- 3.1. The work of the IWG on Particle Measurement Programme should be completed by June 2019. A prolongation and extension of the mandate of the IWG, in relation to the development and validation of new test procedures, e.g. in relation to PN measurement systems compatible with Portable Emissions Measurement Systems (PEMS), tyre/brake wear if necessary, should be considered in due time by GRPE.

## **4. Scope and work items**

### **A. Exhaust particle emissions**

- 4.1. PM mass exhaust measurement

Note:

- (a) HD and Non-Road Mobile Machinery (NRMM) PM measurement excluded from the terms of reference as have recently been extensively revised in the respective GTRs. It is not foreseen that further major technical adaptation is required in the near term.
- (b) LD could also be excluded on a similar basis owing to recent revisions into the GTR on WLTP. It is not foreseen that further major technical adaptation is required in the near term.

- 4.2. PN exhaust measurement

- 4.2.1. Existing scope of PN measurements to be adapted to technical progress, as appropriate:

- (a) LD Compression Ignition (CI) vehicles;
- (b) HD CI engines/vehicles;
- (c) LD Positive Ignition (PI) direct injection engine vehicles;

- (d) HD PI direct injection engines/vehicles.

4.2.2. Extension of scope:

- (a) Investigate particle number emissions from vehicles equipped with PI direct injection during regeneration when vehicles with such technology are available on the market;
- (b) Engine dyno raw exhaust PN measurements for HD for use at Type Approval.

4.3. PN measurement equipment – HD and LD

4.3.1. Existing PMP PN measurement equipment d50 reduction:

- (a) Determine what modifications are required to modify the d50 of the existing PN measurement methodology from 23 nm to approximately 10 nm. Assess the impact of such modifications on particle number emissions/repeatability/reproducibility;

Objective: NRMM/HD/LD common measurement system

- (b) Determine whether LD diesel regeneration measurements can be accurately, reliably, in a repeatable way and reproducibly made using the new cut-off size;
- (c) Develop Type Approval raw exhaust PN measurement method suitable for engine dyno HD and NRMM.

4.4. Calibration guidelines

4.4.1. Update of existing calibration guidelines:

- (a) Review and update of the calibration guidance documents relating to the Particle Number Counting (PNC) and VPR (Volatile Particle Remover), taking into account of:
  - (i) Technical progress;
  - (ii) The work of European Metrology Research Programme (EMRP) ENV-02;
  - (iii) ISO 27891;
  - (iv) VPR Round Robin (RR): fundamental calibration of the Condensation Particle Counter (CPC) and recommendations on LD aerosols;
- (b) Compilation of relevant calibration literature and review for inclusion of best practices;
- (c) Review and update of the calibration guidelines for CPC and VPR if the lower particle size d50 cut-off of the PMP of 23 nm is reduced.

## **B. Non-exhaust particle emissions**

4.5. Brake wear Particulate Matter (PM) measurement

4.5.1. Development of a suggested common test procedure for sampling and assessing brake wear particles both in terms of mass and number:

- (a) Selection or development of a test cycle appropriate for the investigation of brake wear particles;

- (b) Investigation and selection of the appropriate methodologies for particles generation and sampling. Definition of the appropriate test rig configuration;
  - (c) Investigation and selection of the appropriate instrumentation for the measurement and characterization of brake wear particles.
- 4.6. Tyre/Road wear Particulate Matter (PM) measurement:
- (a) Continue monitoring ongoing projects and published data on the physical nature and size distribution of particle emissions from tyre/road wear;
  - (b) Provide a report on the investigation status and recommended next steps for consideration at the GRPE January 2019 session.
- 4.7. The IWG on Particle Measurement Programme should complete the tasks of this section by June 2019. A prolongation and extension of the mandate of the IWG for the above tasks should be considered in due time by GRPE.

## **5. Rules of procedure**

- 5.1. The IWG is open to all participants of GRPE. A limitation of the number of participants from any country or organization to participate in the IWG is not foreseen.
- 5.2. A Chair and a Secretary will manage the IWG.
- 5.3. The working language of the IWG will be English.
- 5.4. All documents and/or proposals shall be submitted to the Secretary of the IWG in a suitable electronic format, preferably in line with the UNECE guidelines in advance of the meetings. The IWG may refuse to discuss any item or proposal which has not been circulated at least five working days in advance of the scheduled meeting.
- 5.5. The IWG shall meet regularly at the GRPE meetings in Geneva. Additional meetings will be organized upon demand.
- 5.6. An agenda and related documents will be circulated to all members of the IWG in advance of all scheduled meetings.
- 5.7. The work process will be developed by consensus. When consensus cannot be reached, the Chair of the IWG shall present the different points of view to GRPE. The Chair may seek guidance from GRPE as appropriate.
- 5.8. The progress of the IWG will be routinely reported to GRPE orally or as an informal document by the Chair or the Secretary.
- 5.9. All working documents shall be distributed in digital format. The specific PMP section on the UNECE website shall continue to be utilised.

## Annex V

### Amendments to ECE/TRANS/WP.29/GRPE/2016/12

#### Adopted on the basis of GRPE-73-04 (see para. 29)

*In ECE/TRANS/WP.29/GRPE/2016/12,*

*Annex 3, paragraph 1.2., amend to read:*

"1.2. The information of all the actual applications together with each specific retrofit system in accordance with the table in Appendix 1 of this annex shall be attached as an appendix."

*Annex 4, paragraph 1.3., amend to read:*

"1.3. The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle defined below. The approval number consists of the retrofit system type approval number, which appears in the communication form for this type approval (see paragraph ~~4.2~~ 5.1.2. and Annex 5) preceded by two figures indicating the latest series of amendments to this Regulation."

*Annex 6, paragraphs 11.1.2. and 11.1.3., amend to read:*

"11.1.2. Application range extension

**In case of a test for an application range extension in accordance with the provisions set out in paragraph 5.2.2. or 10.1.1.,** the vehicle shall be fuelled with diesel market fuel and a gaseous market fuel in the range for which the engine retrofit system is approved. It is recommended to use the gaseous fuel with the lowest Methane Number rating within this fuel range.

The application range extension may be restricted to a smaller fuel range than the fuel range of the initial application range, but in that case the fuel range of the actual applications shall also be restricted.

11.1.3. Actual applications

Actual applications may be restricted to a smaller fuel range than the application range, but this shall be indicated on the notification form at the time of the notification and on the plate specified in paragraph 5.2.1. **of this Regulation.**

Only fuels within the range for which the engine retrofit system is compliant with this Regulation may be used.

The user manual shall clearly specify which market fuels may be used."

*Annex 6, paragraph 12.9.3., amend to read:*

"12.9.3. The installation manual shall contain the necessary instructions to access the retrofit system parts information system referred to in paragraph 5.2.3. **of this Regulation.**"

## Annex VI

### Amendments to ECE/TRANS/WP.29/GRPE/2016/13

Adopted on the basis of GRPE-73-16 (see para. 32)

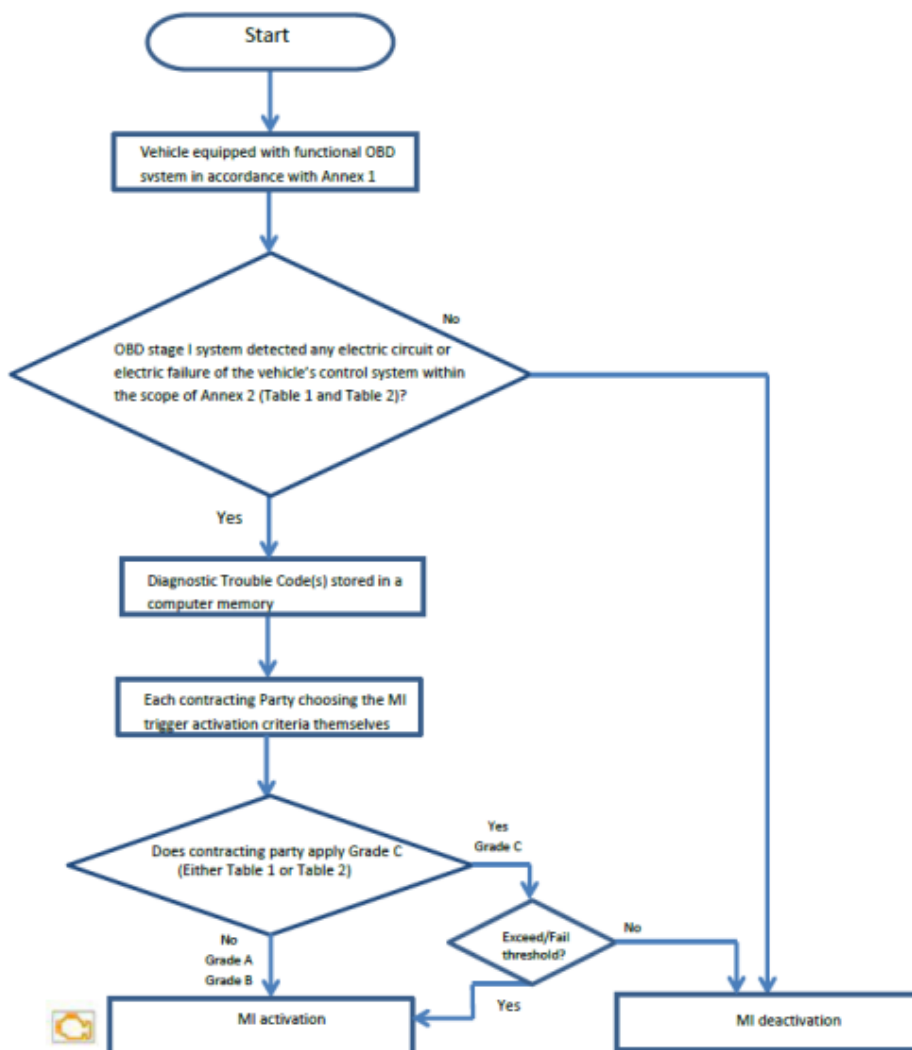
In ECE/TRANS/WP.29/GRPE/2016/13,

Section I (Statement of technical rationale and justification),

Paragraph 16., Figure 1, amend to read:

"Figure 1

**Flowchart MI trigger activation criteria**



Section II (Text of the global technical regulation),

Paragraph 2., amend to read:

## "2. Scope and application

~~Two and three wheeled vehicles equipped with a propulsion unit in accordance with Table 1.~~

~~[Contracting Parties are requested to consider the details of this UN gtr while enacting national/regional regulations for OBD for other vehicles of category 3]~~

**Two- and three-wheeled vehicles of category 3<sup>1</sup> equipped with a propulsion unit in accordance with Table 1.**

Table 1  
Scope with regard to the propulsion unit and fuel type

<i>Propulsion unit and fuel type</i>				<i>Functional OBD</i>	<i>Test type VIII (1)</i>
Vehicle with PI engine	Mono-fuel*	Petrol		Yes	
		LPG		Yes	
		NG / Biomethane		Yes	
	Bi-fuel	Petrol	LPG	Yes	
		Petrol	NG / Biomethane	Yes	
		Petrol	Hydrogen	Yes	
	Flex-fuel	Petrol	Ethanol (E85)	Yes	
NG / Biomethane		HCNG	Yes	(2)	
Vehicle with CI engine	Flex-fuel	Diesel	Bio-Diesel	Yes	(3)
	Mono-fuel	Diesel		Yes	
Pure electric vehicle or vehicle propelled with Compressed Air (CA)				<b>No</b>	No
Hydrogen Fuel cell vehicle				<b>No</b>	No
(1) At the discretion of the Contracting Party (2) NG/Biomethane only, at the discretion of the Contracting Party (3) B5 only, at the discretion of the Contracting Party  *Exemption: OBD requirements are exempted in petrol mode of a mono-fuel motor vehicle that is designed primarily for permanent running on LPG or NG / bio-methane or hydrogen, having a petrol system, with a petrol fuel tank capacity not exceeding two litres in the case of two-wheeled motorcycles and motorcycles with sidecar and not exceeding three litres in the case of three-wheeled vehicles, intended for emergency purposes or starting only.					

Paragraph 3.6., amend to read:

"3.6. ~~["Default mode" refers to a case where the engine management controller switches to a setting that does not require an input from a failed component or system]~~"

Paragraph 3.20., amend to read:

<sup>1</sup> ECE/TRANS/WP.29/1045, as amended by Amends. 1 and 2 (Special Resolution No. 1, [www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html](http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html))

- "3.20. "Warm-up cycle" means sufficient vehicle operation such that the coolant temperature rises by at least 22 °C from engine start-up to at least 70°C ~~for the lubrication oil temperature rises by at least [xx] °C from engine start-up to at least [yy] °C. In the case of an air cooled engine as alternative to the coolant temperature either the rise in temperature of the cylinder block or of the cylinder head surface may be selected~~. **If this condition is insufficient to determine the warm up cycle, with the permission of the approval authority, alternative criteria and/or alternative signal(s) or information (e.g. spark plug seat temperature, engine oil temperature, vehicle operation time, accumulative engine revolution, travel distance, etc.) may be adopted. In any case, all signal(s) and information used for determination need to be monitored by the ECU and shall be made available by data stream.**"

Paragraphs 5. to 5.2.5., amend to read:

## **5. General requirements**

- 5.1. Vehicles, systems, and components shall be so designed, constructed and assembled by the manufacturer, so as to enable the vehicle, in normal use and maintained according to the prescriptions of the manufacturer, to comply with the provisions of this UN gtr during its useful life.
- 5.2. OBD stage I
- 5.2.1. The technical requirements of this section shall be mandatory for vehicles in the scope of this UN gtr equipped with an OBD stage I system.
- 5.2.2. The OBD stage I system shall monitor for any electric circuit and electronics failure of the vehicle's control system laid down in Annex 2.
- 5.2.3. Electric circuit diagnostic
- 5.2.3.1. For the purposes of paragraph 5.2.42.3.3. the electric circuit and electronic failure diagnostics with regard to OBD stage I shall at a minimum contain the sensor and actuator diagnostics as well as the internal diagnostics of the electronic control units required in Annex 2.
- 5.2.42. Functional OBD requirements
- 5.2.42.1. Vehicles in the scope of this UN gtr shall be equipped with an OBD stage I system so designed, constructed and installed in a vehicle as to enable it to identify types malfunction over the useful life of the vehicle.
- 5.2.42.1.1. Access to the OBD system required for the inspection, diagnosis, servicing or repair of the vehicle shall be unrestricted and standardised. All OBD relevant diagnostic trouble codes shall be consistent with paragraph 3.11. of Annex 1.
- 5.2.42.1.2. At the manufacturer's discretion, to aid technicians in the efficient repair of vehicles, the OBD system may be extended to monitor and report on any other on-board system. Extended diagnostic systems shall not be considered as falling under the scope of approval requirements.
- 5.2.42.2. The OBD system shall be so designed, constructed and installed in a vehicle as to enable it to comply with the requirements of this UN gtr during conditions of normal use.
- 5.2.42.2.1. Temporary disablement of the OBD system

- 5.2.42.2.1.1. A manufacturer may disable the OBD system at ambient engine starting temperatures below  $-7^{\circ}\text{C}$  or at elevations over 2,500 metres above sea level, provided it submits data or an engineering evaluation which adequately demonstrate that monitoring would be unreliable in such conditions. It may also request disablement of the OBD system at other ambient engine starting temperatures if it demonstrates to the authority with data or an engineering evaluation that misdiagnosis would occur under such conditions.
- 5.2.42.2.1.2. For vehicles designed to accommodate the installation of power take-off units, disablement of affected monitoring systems is permitted provided disablement occurs only when the power take-off unit is active.
- 5.2.42.1.3. ~~In addition to the provisions of this section, {~~The manufacturer may temporarily disable the OBD system in the following conditions:
- (a) For flex-fuel or mono/bi-fuel gas vehicles for one minute after re-fuelling to allow for the recognition of fuel quality and composition by the Powertrain Control Unit(s) (PCU);
  - (b) For bi-fuel vehicles for five seconds after fuel switching to allow for engine parameters to be readjusted;
  - (c) The manufacturer may deviate from these time limits if it can be demonstrated that stabilisation of the fuelling system after re-fuelling or fuel switching takes longer for justified technical reasons. In any case, the OBD system shall be re-enabled as soon as either the fuel quality or composition is recognised or the engine parameters are readjusted.~~}~~
- 5.2.42.3. The OBD system shall monitor for:
- 5.2.42.3.1. At a minimum the electric / electronic circuits required in Annex 2.
- 5.2.42.3.2. If active on the selected fuel, other emission control system components or systems, or emission-related powertrain components or systems, which are connected to a computer.
- 5.2.42.3.3. Unless otherwise monitored, any other electronic powertrain component connected to a computer relevant including any relevant sensors to enable monitoring functions to be carried out, shall be monitored for electric / electronic circuit failures. In particular, these electronic components shall be continuously monitored for any electric circuit continuity failure, shorted electric circuits, electric range / performance and stuck signal of the control system in accordance with Annex 2.
- 5.2.42.4. A sequence of diagnostic checks shall be initiated at each engine start and completed at least once provided that the correct test conditions are met.
- 5.2.42.5. Activation of the Malfunction Indicator (MI)
- 5.2.42.5.1. The OBD system shall incorporate a malfunction indicator readily perceivable to the vehicle operator. The MI shall not be used for any purposes other than to indicate emergency start-up or limp-home routines to the driver. The MI shall be visible in all reasonable lighting conditions. When activated, it shall display a symbol in conformity with ISO 2575:2010, symbol F.01. A vehicle shall not be equipped with more than one general purpose MI used to convey power-train related failures which may affect emissions. Separate specific purpose tell tales (e. g. brake system, fasten seat



- belt, oil pressure, etc.) are permitted. The use of red colour for a MI is prohibited.
- 5.2.42.5.2. For strategies requiring more than two preconditioning cycles for MI activation, the manufacturer shall provide data or an engineering evaluation which adequately demonstrate that the monitoring system is equally effective and timely in detecting component deterioration. Strategies requiring on average more than ten driving cycles for MI activation are not accepted.
- 5.2.42.5.3. The MI shall also activate when the vehicle's ignition is in the "key-on" position before engine starting or cranking and deactivate if no malfunction has been detected. For vehicles not equipped with a battery, the MI shall illuminate immediately after engine starting and shall subsequently be deactivated after 5 seconds, if no malfunction has previously been detected.
- 5.2.42.6. The OBD system shall record diagnostic trouble code(s) indicating the status of the control system. Separate status codes shall be used to identify correctly functioning control systems and those control systems which need further vehicle operation to be fully evaluated. If the MI is activated due to malfunction or permanent default modes of operation, a diagnostic trouble code shall be stored that identifies the type of malfunction. A diagnostic trouble code shall also be stored in the cases referred to in paragraph 5.2.4.3.3. ~~3-11. in Annex 1.~~
- 5.2.42.6.1. The distance travelled by the vehicle while the MI is activated shall be available at any moment through the serial port on the standardised diagnostic connector. By means of derogation for vehicles equipped with a mechanically operating odometer that does not allow input to the electronic control unit, "distance travelled" may be replaced with "engine operation time" and shall be made available at any moment through the serial port on the standardised diagnostic connector. Engine operation time in this context means the total accumulated time in which the propulsion unit(s) provide(s) mechanical output (e.g. the crankshaft of a combustion engine or electric motor rotates) after triggering the MI activation during one or more key cycles.
- 5.2.42.7. Extinguishing the MI
- 5.2.42.7.1. For all malfunctions, the MI may be deactivated after three subsequent sequential driving cycles during which the monitoring system responsible for activating the MI ceases to detect the malfunction and if no other malfunction has been identified that would independently activate the MI.
- 5.2.42.8. Erasing a diagnostic trouble code
- 5.2.4.8.1. The OBD system may erase a diagnostic trouble code and the distance travelled and freeze-frame information if the same fault is not re-registered in at least 40 engine warm-up cycles.
- 5.2.42.8.2. Stored faults shall not be erased by disconnection of the on-board computer from the vehicle power supply or by disconnection or failure of the vehicle battery or batteries.
- 5.2.42.9. Bi-fuelled gas vehicles
- In general, all the OBD requirements applying to a mono-fuelled vehicle apply to bi-fuelled gas vehicles for each of the fuel types (petrol and (NG/biomethane)/LPG)). To this end, one of the following two alternatives in

paragraphs 5.2.42.9.1. or 5.2.42.9.2. or any combination thereof shall be used.

5.2.42.9.1. One OBD system for both fuel types

5.2.42.9.1.1. The following procedures shall be executed for each diagnostic in a single OBD system for operation on petrol and on (NG/biomethane)/LPG, either independent of the fuel currently in use or fuel type specific:

- (a) Activation of Malfunction Indicator (MI) (see paragraph 5.2.42.5.);
- (b) Diagnostic trouble code storage (see paragraph 5.2.42.6.);
- (c) Extinguishing the MI (see paragraph 5.2.42.7.);
- (d) Erasing a diagnostic trouble code (see paragraph 5.2.42.8.).

For components or systems to be monitored, either separate diagnostics for each fuel type can be used or a common diagnostic.

5.2.42.9.1.2. The OBD system can reside in either one or more computers.

5.2.42.9.2. Two separate OBD systems, one for each fuel type.

5.2.42.9.2.1. The following procedures shall be executed independently of each other when the vehicle is operated on petrol or on (NG/biomethane)/LPG:

- (a) Activation of Malfunction Indicator (MI) (see paragraph 5.2.42.5.);
- (b) Diagnostic trouble code storage (see paragraph 5.2.42.6.);
- (c) Extinguishing the MI (see paragraph 5.2.42.7.);
- (d) Erasing a diagnostic trouble code (see paragraph 5.2.42.8.).

5.2.42.9.2.2. The separate OBD systems can reside in either one or more computers.

5.2.42.9.3. Specific requirements regarding the transmission of diagnostic signals from bi-fuelled gas vehicles.

5.2.42.9.3.1. On a request from a diagnostic scan tool, the diagnostic signals shall be transmitted on one or more source addresses. The use of source addresses is set out in ISO 15031-5:2011.

5.2.42.9.3.2. Identification of fuel specific information can be realised as follows:

- (a) By use of source addresses;
- (b) By use of a fuel select switch;
- (c) By use of fuel specific diagnostic trouble codes.

5.2.42.9.4. Regarding the status code (described in paragraph 5.2.42.6.), one of the following two alternatives has to be used if one or more of the diagnostics reporting readiness is fuel type specific:

- (a) The status code is fuel specific, i.e. use of two status codes, one for each fuel type;
- (b) The status code shall indicate fully evaluated control systems for both fuel types (petrol and (NG/biomethane)/LPG) when the control systems are fully evaluated for one of the fuel types.

If none of the diagnostics reporting readiness is fuel-type specific, only one status code has to be supported.}

- 5.2.53. Requirements relating to the approval of on-board diagnostic systems
- 5.2.53.1. A manufacturer may ask the approval authority to accept an OBD system for approval even if the system contains one or more deficiencies so that the specific requirements of this annex are not fully met.
- 5.2.53.2. In considering the request, the authority shall determine whether compliance with the requirements of this annex is unfeasible or unreasonable.
- The authority shall take into consideration data from the manufacturer detailing factors such as, but not limited to, technical feasibility, lead time and production cycles including phase-in or phase-out of engines or vehicle designs and programmed upgrades of computers, the extent to which the resultant OBD system will be effective in complying with the requirements of this Regulation and whether the manufacturer has demonstrated an acceptable level of effort to comply with those requirements.
- 5.2.53.2.1. The authority shall not accept any deficiency request that includes the complete lack of a required diagnostic monitor.
- 5.2.53.3. Prior to, or at the time of, approval, no deficiency shall be granted in respect of the requirements of **paragraph 3. of Annex 1** ~~paragraph 5.2.3,~~ except ~~paragraph 3.4.~~ **3.11.** of Annex 1.
- 5.2.53.4. Deficiency period
- 5.2.53.4.1. A deficiency may be carried over for a period of two years after the date of approval of the vehicle type unless it can be adequately demonstrated that substantial vehicle hardware modifications and additional lead-time beyond two years would be necessary to correct it. In such a case, it may be carried over for a period not exceeding three years.
- 5.2.53.4.2. A manufacturer may ask the approval authority to grant a deficiency retrospectively when it is discovered after the original approval. In this case, the deficiency may be carried over for a period of two years after the date of notification to the administrative department unless it can be adequately demonstrated that substantial vehicle hardware modifications and additional lead-time beyond two years would be necessary to correct it. In such a case, it may be carried over for a period not exceeding three years.
- 5.2.53.5. The authority shall notify all other Contracting Parties of its decision on granting a deficiency request.
- 5.2.64. Propulsion family definition with regard to OBD and in particular to test type VIII
- 5.2.64.1. A representative parent vehicle shall be selected to test ~~and demonstrate to the approval authority~~ the functional on-board diagnostic requirements set out in Annex 1 and if applicable to verify the test type VIII requirements laid down in Annex 3 if this is applied by the Contracting Party based on the grade laid down in Table 1 of Annex 2 and the propulsion family definition laid down in Annex 4. All members of the family shall comply with the applicable requirements and performance limits set out in this UN gtr.
- 5.2.75. Documentation
- The vehicle manufacturer shall complete the information document in accordance with the items listed in Annex 5- ~~and submit it to the approval authority~~."

*Annex 1, paragraphs 3.1. and 3.1.1., amend to read:*

- "{3.1. Except in the case of grade A OBD, upon determination of the first malfunction of any component or system, "freeze-frame" engine conditions present at the time shall be stored in computer memory in accordance with the specifications in paragraph 3.10. Stored engine conditions shall include, but are not limited to, calculated load value, engine speed, fuel trim value(s) (if available), fuel pressure (if available), vehicle speed (if available), coolant temperature (if available), intake manifold pressure (if available), closed- or open-loop operation (if available) and the diagnostic trouble code which caused the data to be stored}.
- {3.1.1. Except in the case of grade A OBD, the manufacturer shall choose the most appropriate set of conditions facilitating effective and efficient repairs in freeze-frame storage. Only one frame of data is required. Manufacturers may choose to store additional frames provided that at least the required frame can be read by a generic scan tool meeting the specifications of paragraphs 3.9. and 3.10. If the diagnostic trouble code causing the conditions to be stored is erased in accordance with paragraph 5.2.4.8.1. of section II the stored engine conditions may also be erased}."

*Annex 1, paragraph 3.2., amend to read:*

- "{3.2. Except in the case of grade A OBD, if available, the following signals in accordance with the specifications in paragraph 3.10. in addition to the required freeze-frame information shall be made available on demand through the serial port on the standardised diagnostic connector, if the information is available to the on-board computer or can be determined using information available to the on-board computer: number of stored diagnostic trouble codes, engine coolant temperature, fuel control system status (closed-loop, open-loop, other), fuel trim, ignition timing advance, intake air temperature, manifold air pressure, air flow rate, engine speed, throttle position sensor output value, secondary air status (upstream, downstream or atmosphere), calculated load value, vehicle speed, ~~the position of the antilock brake system switch (on/off)~~, the activated default mode(s) and fuel pressure}.

The signals shall be provided in standard units based on the specifications in paragraph 3.10. Actual signals shall be clearly identified separately from default value {for limp-home signals}."

*Annex 1, paragraph 4.2.3., amend to read:*

- "4.2.3. A comprehensive document describing all sensed components with the strategy for fault detection and MI activation (fixed number of driving cycles or statistical method), including a list of relevant secondary sensed parameters for each component monitored by the OBD system and a list of all OBD output codes and format used (with an explanation of each) associated with individual emission related powertrain components and individual non-emission related components, where monitoring of the component is used to determine MI activation. ~~In particular, a comprehensive explanation for the data in service \$ 05 Test ID \$ 21 to FF and the data in service \$ 06 shall be provided. In the case of vehicle types that use a communication link in accordance with ISO 15765 4 "Road vehicles - Diagnostics on Controller Area Network (CAN) - Part 4: Requirements for emissions related systems", a comprehensive explanation for the data in~~

~~service \$ 06 Test ID \$ 00 to FF, for each OBD monitor ID supported, shall be provided."~~

*Annex 1, paragraph 4.2.5., amend to read:*

- "4.2.5. If an approval authority receives a request from any interested components, diagnostic tools or test equipment manufacturer for information on the OBD system of a vehicle that has been type approved **by that type approval authority** to a previous version of **this Regulation (if any)**,
- (a) ~~The That approval~~ authority shall, within 30 days, ask the manufacturer of the vehicle in question to make available the information required in paragraphs 3.1. and 3.2.;
- (b) The **vehicle** manufacturer shall submit this information to ~~the that~~ approval authority within two months of the request;
- (c) ~~The That approval~~ authority shall transmit this information to the other Contracting Parties' approval authorities and ~~the approval authority which granted the original approval~~ shall attach this information to the vehicle approval information."

*Annex 2, paragraphs 2.5. and 2.6., amend to read:*

- "2.5. Exemptions regarding detection
- Exemption from detecting certain electric circuit monitoring symptoms may be granted if the manufacturer can demonstrate ~~to the technical service~~ {to the satisfaction of the approval authority} that the only feasible monitoring strategy would negatively affect vehicle safety or driveability in a significant way.
- 2.6. Exemption regarding OBD emission verification tests (test type VIII)
- At the request of the manufacturer and based on a technical justification {to the satisfaction of the approval authority}, certain OBD monitors listed in Table 2 may be exempted from test type VIII emission verification tests referred to in Annex 3 under the condition that the manufacturer can demonstrate to the approval authority that:"

*Annex 2, paragraphs 2.6.2. to 2.7.1., amend to read:*

- "2.6.2. Monitoring of some of the items listed in Table 2 is physically not possible **and a deficiency has been granted for this incomplete monitor**. The comprehensive, technical justification why such an OBD monitor cannot run shall be added to the information folder.
- {2.7. Exemptions grade A
- 2.7.1. Grade A on-board diagnostic systems are exempted from the requirements set-out in:
- (a) Paragraphs 3.1. and 3.2. of Annex 1;}"

*Annex 2, paragraph 2.8.2., amend to read:*

- "2.8.2. If the OBD parameter does not require the vehicle to be driven for MI activation, the test vehicle can be considered meeting circuit discontinuity testing for the tested OBD fault mode, **if the MI activates under the conditions described in paragraphs 2.6.1., 2.6.1.1. and 2.6.1.2.**"

*Annex 3, paragraph 1.2., amend to read:*

"1.2. The manufacturer shall make available the defective components or electrical devices to be used to simulate failures. When measured over the appropriate test type I cycle, such defective components or devices shall not cause the vehicle emissions to exceed by more than 20 percent the OBD emission thresholds if the Contracting Party applies these fail thresholds as MI activation performance criteria. **For electric failures (short/open circuit) the emissions may exceed the OBD emission thresholds by more than 20 per cent.**"

*Annex 3, paragraphs 3.1. to 3.4.2., amend to read:*

~~"3.1. Test vehicle~~

~~3.1.1. [The environmental OBD verification and demonstration tests shall be carried out on a test vehicle that shall be properly maintained and used, dependent on durability requirements of pollution control devices at the discretion of the Contracting Party].~~

~~3.1.2. [The test vehicle(s) shall be equipped with the aged emission components used for durability tests. The OBD environmental verification tests are to be finally verified and reported on the durability of pollution control devices].~~

3.12. The OBD system shall indicate the failure of any of the devices in accordance with Annex 2.

3.23. The test type I data in the template for a test report according to the template set out in UN gtr No. 2, including the used dynamometer settings and applicable emission laboratory test cycle, shall be provided for reference.

3.34. The list with PCU / ECU malfunctions shall be provided:

3.34.1. For each malfunction that leads to the OBD emission thresholds, if the Contracting Party applies these fail thresholds as MI activation performance criteria, in both non-defaulted and defaulted driving mode being exceeded. The emission laboratory test results shall be reported in those additional columns in the format of the information document referred to in Annex 5;

3.34.2. For short descriptions of the test methods used to simulate the emission-relevant malfunctions, as referred to in paragraph 4."

*Annex 3, paragraph 5.1., amend to read:*

"5.1. Test vehicle

The aged, test parent vehicle(s) **or a new vehicle fitted with defective components or electrical devices** shall meet the propulsion unit family requirements laid down in Annex 4 and relevant requirements laid down in UN gtr No. 2. The distance accumulation and ageing test procedure is at the discretion of the Contracting Party."

*Annex 5, paragraph 2.1.2.11., amend to read:*

"2.1.2.11. The information required in paragraphs 2.1.2.1. to 2.1.2.4-10. may be provided in table form as described in the following table;

..."

*Annex 5, paragraph 2.2., to be deleted:*

~~"[2.2. Repair and Maintenance Information (RMI) in a standardised format, as required by national authorities.]"~~

## Annex VII

### **Technical report on the development of a new global technical regulation on the measurement procedure for two- or three-wheeled motor vehicles equipped with a combustion engine with regard to the on-board diagnostics**

Adopted on the basis of GRPE-73-18-Rev.1 (see para. 32)

#### **I. Introduction**

1. The industry that produces two- and three-wheeled motor vehicles in the scope of this UN global technical regulation (gtr) is global with companies selling products in many different countries. The Contracting Parties to the 1998 Agreement have determined that work should be undertaken to address the environmental and propulsion unit performance requirements of two- and three-wheeled motor vehicles, among others as a way to help improve air quality internationally. This gtr is directed at harmonizing On-Board Diagnostic requirements (OBD) for two- and three-wheeled motor vehicles, though not fully similar as was targeted with UN gtr No. 5 for OBD requirements of heavy-duty motor vehicles. The common set of agreed rules in the area of OBD allows the Contracting Parties to realise their own domestic objectives and to pursue their own levels of priorities. Nonetheless, this UN gtr has been structured in a manner that facilitates a further extension of OBD requirements and to enhance the OBD objectives in the future.

2. An OBD system is an electronic system fitted on-board of a motor vehicle that has the capability of identifying the likely area of malfunction by means of fault codes stored in a computer memory which can be accessed by means of a generic scan tool. The Diagnostic Trouble Codes (DTCs), diagnostic signals like, e.g. data stream and freeze frame and the communication protocol are harmonized and standardized so that a repair person can efficiently determine which functionality of the vehicle is malfunctioning and analyse the failures before starting the actual repair of the vehicle. Generic scan-tools are widely available at a relatively low price and allow access to the OBD information without having to resolve technical incompatibilities and constraints. A major output of the OBD system is activation of a Malfunction Indicator (MI) on the instrument cluster to indicate to the driver that the vehicle is possibly broken and that the malfunction is serious enough to repair the vehicle as soon as possible.


3. For the purpose of coherency between UN gtrs on the same subject but with different motor vehicle types in its scope AC.3 underlined the importance of the principles laid down in UN gtr No. 5 regarding on-board diagnostic systems of heavy-duty motor vehicles, reading:

*"Recent years have seen a rapid increase in the number of vehicle functions that depend upon the use of electrical/electronic control. This trend is expected to continue. Further, the emissions control systems on highway vehicles are not the only systems for which OBD capability is important. Vehicle systems provided to manage or deliver safety control are also equipped with diagnostic capability. Recognizing this fact, and the negative implications that non-standardized diagnostics can have on maintenance and inspection procedures, this UN gtr has been structured such that further OBD functionality - e.g. OBD for safety related systems - could be added in the future as and when appropriate."*

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4. Despite different views within the EPPR IWG during the drafting process it has been possible to resolve controversial issues and bridge different positions of Contracting Parties and jointly develop wording that in the end was acceptable for country representatives and stakeholders. Herewith finding a common denominator in the complex field of OBD for two- and three-wheeled vehicles, allowing each Contracting Party to address national needs but on a solid basis of world harmonized requirements. The UN gtr text was drafted allowing harmonization to the extent possible and to pave the road for further converging of rules in the future.

## **II. Objective of the UN gtr on on-board diagnostics**

5. The objectives of this UN gtr are:

- (a) Able to provide an internationally harmonized set of functional OBD requirements on the "infra-structure" on-board of a motor vehicle in the scope of this UN gtr, which determines hardware and software design in a technology neutral way and that considers technical feasibility and cost-effectiveness, such as:
  - (i) Minimum monitoring requirements of electric and electronic circuits and failure mode detection as well as for monitoring of the control module(s) within the scope of OBD stage I;
  - (ii) Provisions regarding Diagnostic Trouble Codes (DTC), diagnostic signals and connection interfaces;
  - (iii) Provisions regarding access to OBD information which is needed as input to the repair process of a broken motor vehicle;
- (b) Allowing referencing of international technical standards already established for other motor vehicle types with a proven track record of providing clarity for the design and configuration of the OBD system;
- (c) Able to provide an internationally harmonized set of tests to ensure efficient and practicable testing;
- (d) Corresponding to state-of-the-art testing technology, allowing to simulate failures where technically feasible;
- (e) Applicable in practice to existing and foreseeable future powertrain technologies;
- (f) Definition of propulsion unit families with regards to OBD.

6. The UN gtr also cover harmonized requirements to conduct the environmental verification test procedure (test type VIII) relating to OBD, which is a test procedure by simulating a failure of an emission relevant component in the powertrain management system and its emission control system which is used for type approval of an OBD system. Subsequently the OBD system reaction and detection of the failure is monitored and reported where necessary during type I tailpipe emission verification tests.



### **III. Controversially discussed subjects in the area of the measurement procedure for two- or three-wheeled motor vehicles with regard to on-board diagnostics, compromises and decisions taken by the EPPR IWG**

7. A number of subjects within the draft UN gtr on on-board diagnostics led to discussions within the EPPR IWG and the different views and positions among the participants were debated at length, sometimes leading to long-standing open issues. For the largest share of these more difficult subjects a compromise could be worked out; for a few subjects the EPPR IWG decided to postpone the discussions and to reopen the debate at a later point in time when more scientific evidence is collected and available for assessment. The controversially discussed subjects, the associated compromises and decisions by the EPPR IWG are the following:

8. Objectives as well as fundamental principles of use and applicability of OBD

- (a) Despite fundamental differences in opinion among the EPPR IWG members on objectives, the use and applicability of the OBD UN gtr, solutions were found that are satisfactory for the parties involved. It was possible to find wording that allows the Contracting Parties to harmonize OBD requirements to the largest extent possible and to apply it for the purposes needed. In many sessions the debate was held in the EPPR IWG meetings regarding the justification of introducing OBD requirements and the prioritisation in applicability of OBD;
- (b) Traditionally the OBD requirements of light-duty motor vehicle categories 1 and 2, that have served as the basis for this UN gtr, have exclusively served the purpose of environmental protection with an associated rationale and practical implementation. The core OBD elements are given below:

- (i) Diagnostic Trouble Code (DTC)

One or more DTCs are logged in the powertrain controller's memory if one or more malfunctions are detected and confirmed. These harmonized codes allow identification of the failing devices in the vehicle's powertrain and help the service technician to investigate and analyse the malfunctioning systems and components. Historically in emission legislation DTCs have been defined within a narrow scope. The DTCs have only been standardised for light- and heavy-duty motor vehicles in the past when these were affecting the vehicle's environmental performance in terms of tailpipe and evaporative emissions, detected, confirmed and stored in the emission controller on-board of the motor vehicle.

At the same time vehicle manufacturers defined their own proprietary DTCs that allow authorized repairers to identify broken functionality on-board of the entire vehicle above and beyond the boundaries of emission relevant diagnostics. It concerns diagnosis of failing auxiliaries, safety-critical powertrain functionality as well as for failure identification of vehicle comfort functions that do not any longer operate according to the manufacturer's design specifications;

- (ii) Freeze frame

A so-called freeze frame is stored in the controller's memory upon a detected, confirmed and stored DTC. This electronic file is a snapshot

of powertrain data and relevant ambient conditions allowing a repairer or an enforcement authority to retrieve relevant powertrain information retroactively in order to reproduce the conditions under which the system or component has failed, e.g. the engine and vehicle speeds, throttle position, etc. Again, the freeze frame has been defined within the narrow scope of environmental performance, only storing data if a tailpipe emissions relevant malfunction is detected, which has been confirmed and stored in the controller's memory;

(iii) Malfunction Indicator (MI)

The MI, typically a standardised warning light visible on the instrument panel, is briefly activated at key-on, engine off or ignition-on as bulb check and then turned-off again if the system has not detected a malfunction. The orange engine symbol shall be permanently illuminated on the cluster if an emission relevant malfunction is detected, confirmed by the OBD system and logged in the controller's memory. This, in order to notify the driver that the system has detected one or multiple emission relevant DTCs. The underlying assumption is that if the driver is notified by the MI in time, he/she will visit a service station (repair workshop) as quickly as possible and have the emission relevant failure repaired, resulting in significantly lower tailpipe emissions.

For other types of detected errors, e.g. failing comfort and/or safety critical malfunctions, it is left to the discretion of the vehicle manufacturer if and how this information is transmitted to driver and repairer. The vehicle manufacturer might opt installing a second tell-tale displayed on the instrument cluster, sometimes referred to as "service soon light". However, with a few exceptions like the anti-lock brake system check light or lighting indicators there are no legal requirements for tell tales fitted to two- and three-wheeled motor vehicles informing the driver of a malfunctioning vehicle. Consequently, each manufacturer is free to handle the transmission of such information as well as the diagnostic contents differently as they deem appropriate;

(iv) Communication protocol

A standardised communication protocol for emission relevant failures is obligatory in approval legislation. This is a common computer language, allowing an off-board generic scan tool to communicate with the on-board diagnostic system and for the service mechanic to read-out stored malfunctions and the freeze frame. The harmonized protocol also allows actuator tests commanded by the scan tool to verify if actuators on-board of the vehicle still work as designed. The protocol is also used in case of re-programming the emission controller, if needed;

(v) OBD connector

In the initial proposal for the UN gtr, the OBD connector that was standardised for cars or any alternative connector was included in the proposal as interface for two- and three-wheeled vehicles. To reduce the number of connector configurations around the globe, the alternative connector was replaced, taking into account the

development an ISO standard for OBD connector for two- and three-wheeled vehicles.<sup>1</sup>

Following some questions raised within the IWG on the vibration and temperature performance of the draft ISO standard<sup>1</sup>, the ISO working group that developed the standard (ISO TC22/SC38/WG4) provided an explanation to EPPR IWG.

9. A paradigm shift was proposed by the EU in the fundamental principles of use and applicability of OBD though some items such as the shift regarding functional safety and comfort were not retained to be part of the scope of this UN gtr:

- (a) The conventional paradigm in OBD requires that if an "emission" relevant malfunction occurs is detected, the associated DTCs and freeze frame are stored in the controller's memory. Subsequently the MI is activated to notify the driver, who then should go to a service station to have the malfunction repaired. Upon arrival at the service station of the highly polluting vehicle owing to the active malfunction(s), the repairer can connect a generic scan tool directly to the OBD connector and swiftly obtain the vehicle's on-board diagnostic information as input for the analysis and the actual repair. After successful repair of the vehicle the pollutant emission levels should again be low, complying to the designed levels under the approved pollutant emission limits that are prescribed in regional or national environmental performance legislation over the vehicle's useful life;
- (b) In the view of the EU many components in the powertrain management system are not only critical for the environmental performance of a vehicle but are also of key importance for functional safety and other vital vehicle functions. Functions of systems and components can only artificially be separated in environmental and other functionality, in practice sensors, actuators, the data transfer system and powertrain management functions serve many purposes simultaneously. For example, the crankshaft sensor provides rotation speed information to the powertrain controller, which is used as input for a large number of different functions build into the powertrain software. This functionality concerns among others:
  - (i) Functional safety, e.g. rotation speed information to determine if the engine is running as one of the variables to automatically turn on lighting or day-time running lights;
  - (ii) Environmental protection, e.g. rotation speed information used as input for the closed loop fuelling system;
  - (iii) Default information providing partial redundancy for other functions and back-up mode information in case of broken sensors, e.g. rotation speed as input to calculate roughly vehicle speed in case of a broken vehicle speed sensor or allowing to start and partially operate the engine in case of a broken cam sensor;
  - (iv) Information to the rider, e.g. rotation speed information as input to the engine speed gauge on the instrument cluster directly or to calculate a ratio, composed by the rotation speed divided by vehicle speed,

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<sup>1</sup> Motorcycles and Mopeds — Communication between vehicle and external equipment for diagnostics — Diagnostic connector and related electrical circuits, specification and use. ISO/DIS 19689

allowing to determine the gear selected without having to install a gear selection sensor, which can be used as input to the gear indicator display on the instrument cluster;

- (v) Comfort functions, e.g. rotation speed information as indicator for electric generator power used as one of the input variables to activate and operate electric seat or handle heating.
- (c) With other words, the choice that e.g. the crank sensor is relevant for environmental protection only and to make it therefore subject to on-board diagnostic requirements has been a matter of debate in a historic decision process in the IWG EPPR;
- (d) In the EU this traditional paradigm has already been shifted in approval legislation of L-category vehicles in force towards OBD information mainly needed for the effective and efficient repair of the vehicle. Effective repair means that the repairer is able to replace or repair that part of the vehicle that is actually broken. Efficient repair means that the repairer can fast identify the smallest identifiable or exchangeable "broken" unit;
- (e) European Commission promoted that changing priorities from environmental protection only to the actual repair of the vehicle should help create a level playing field between authorized repairers and independent operators in the repair market. This, independent if the repair concerns an environmental protection issue, functional safety or any other type of vehicle functionality related malfunction. Moreover, this approach emphasizes the importance of OBD for the consumer as increased competition among service providers is expected to lead to lower repair prices and a better repair quality;
- (f) Nevertheless, the OBD provisions set out in EU approval legislation<sup>2</sup> have been based on chapter 11 of Revision 4 of Regulation No. 83, which has been developed and agreed in the past based on the conventional paradigm related to environmental protection only. The EU OBD package for two- and three-wheeled vehicles in force is ready for further adaptation to technical progress in support of this paradigm shift and is aligned at the same time with the requirements set out in this UN gtr;
- (g) The EU proposed this same approach to the EPPR IWG but this was not deemed acceptable for the larger share of Contracting Parties and stakeholders for various reasons. The EPPR IWG agreed that the UN gtr, once established, might be further developed in the future and other useful areas of harmonization in the field of OBD might be explored. It was deemed most important to establish the UN gtr within the planned timeframe, addressing the agreed mandate aiming to environmental protection by identifying common denominators in requirements and to phrase the requirements so as to allow all Contracting Parties to use the requirements for their purposes and objectives.

10. Scope in terms of functionality included; split between OBD stages I and II:

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<sup>2</sup> OBD requirements for the approval of L-category vehicles for the European internal market are laid down in Regulation (EU) No 168/2013, Annex XII of Regulation (EU) No 44/2014 and Annex VIII of Regulation (EU) No 134/2014

- (a) The OBD requirements for light- and heavy-duty motor vehicles globally have been compiled over several decades starting roughly in the 1970's in the United States of America. Owing to growing similarities in principle engine management system designs between modern two- and three-wheeled motor vehicles on the one hand and light-duty motor vehicles on the other hand, it seems obvious to carry over existing light-duty motor vehicle requirements as much as possible. However, it appeared that the gap between not being subject to any OBD requirement in approval legislation of two- and three-wheeled motor vehicles and the established rules applicable for light-duty motor vehicles today cannot be closed in one step for several reasons. This gap may therefore be bridged in two distinct steps, through OBD stages I and II;
  - (b) The precise boundaries what type of diagnostics should be allocated to OBD stage I and which ones to OBD stage II have not been precisely defined in light-duty motor vehicle approval legislation under UNECE, which could therefore not be used as benchmark for the EPPR IWG. The EPPR IWG decided to apply OBD I and II as set out in the EU and to incorporate explicit malfunctions and symptoms to precisely define OBD stage I with appropriate requirements. Roughly the EPPR IWG decided that OBD stage I is to contain monitoring requirements of electric and electronic circuits of the powertrain management system and failure mode detection as well as for monitoring of the powertrain control module(s);
  - (c) OBD stage I should not oblige manufacturers to change or add fuelling or ignition hardware and should not impose fitting of an electronic carburettor, electronic fuel injection or electronically controlled ignition coils, providing the vehicle complies with the applicable environmental performance requirements. Compliance with the OBD stage I requirements implies that if fuel delivery, spark delivery or intake air hardware is electronically controlled by electric and/or electronic circuits as well as by a dedicated control module, the applicable input or output circuits of that control module need to be monitored, limited to the items and failure modes listed in the table of the UN gtr. OBD stage I should also not oblige Contracting Parties to change their objectives what should be achieved with on-board diagnostic requirements, in particular not be limited to environmental protection only;
  - (d) Consequently, in the future, if deemed appropriate by WP.29 and once the basis for OBD stage I is established, the UN gtr may be further developed and amended to incorporate OBD stage II requirements. This further stage might then also cover enhanced electric and electronic circuit diagnostics, not yet covered by and in addition to the circuit malfunctions such as sensor rationality diagnostics. It should then also be discussed whether diagnostics related to degradation of systems and components should be included in the future scope as it is today the case for other motor vehicle types. Also, in-use performance ratio monitoring and harmonized OBD performance requirements, such as degradation thresholds triggering the OBD system may be discussed;
  - (e) The EPPR IWG decided in this first stage not to harmonize dedicated functional safety requirements.
11. Discussion of scope in terms of motor vehicle types included:
- (a) The scope in terms of vehicle types included was a horizontal issue for all the draft UN gtrs developed by the EPPR IWG involving the questions:

- (i) Whether three-wheeled should be taken in the scope of the draft UN gtr?;
  - (ii) Whether other propulsion unit types besides the conventional combustion engine should be included in the scope?;
  - (iii) Whether the classification criteria of Special Resolution No. 1 are appropriate and whether the specific classification 3-1, 3-2, 3-3, etc. should be directly referenced or the reference should be done in a more generic way?;
  - (iv) Whether the exclusion criteria of the scope should be set out as well in the scope table or these exclusion criteria should have been described in full text?;
  - (v) How to deal with in- or exclusion of the various propulsion unit and fuelling types?
- (b) The scope in terms of motor vehicle types included has been one of the more challenging items to resolve. The EPPR IWG settled for a compromise as set out in the scope section of the UN gtr submitted for adoption by GRPE.

12. Scope in terms of harmonized OBD data and information

The IWG on EPPR had an intense debate on and the assessment of access to relevant data and information:

- (a) Access to OBD data: This is typically data from the on- and/or off-board diagnostic systems, which requires interpretation to become diagnostic information relevant for the repair of the vehicle. Obtaining this information in the diagnostic or pre-repair stage is paramount to identify the system or component of the vehicle that has failed and that needs repair or maintenance. The EPPR IWG agreed that this type of diagnostic data and information should be within the scope of the gtr;
- (b) Access to repair and maintenance information: This is the step that typically commences after successful diagnostics has been completed or is needed in an iterative process of diagnostics and repair. The appropriateness of repair and maintenance information therefore is highly dependent on correct pre-repair stage OBD information as input so as to effectively and efficiently be able to repair a vehicle. The EPPR IWG decided that, similar as in the case of UN gtr No. 5 on heavy-duty vehicle on-board diagnostics, this type of repair and maintenance information shall remain outside the scope of the UN gtr, which offers the flexibility to each Contracting Party to formulate requirements on this type of information, e.g. in line with the relevant standard: ISO/DIS 18541-6, Standardized access to automotive RMI - Part 6: L-Category vehicle specific RMI use cases and requirements or as deemed appropriate;
- (c) Diagnostic signal regarding freeze frame and data stream: There was a long discussion regarding the freeze frame and data stream among the Contracting Parties from the viewpoint of the aspect of reparability. The EPPR IWG finally agreed that both requirements to be exempted in case of Grade-A, provided that these exemptions are only applied to OBD-I. That is to say, the freeze frame and the data stream are implemented at the first stage when the discussion resumes on OBD-II in the near future.

13. Malfunction Indicator (MI) performance thresholds:

- (a) In the context of the debated paradigm shift in OBD requirements the EU proposed introducing MI performance thresholds based on tailpipe emission thresholds and a torque threshold, independent if the triggered malfunction is allocated to circuit diagnostics attributed to OBD stage I or to more comprehensive diagnostics features possibly set out in future OBD stage II requirements. The proposed rationale behind this proposal, which is applied in EU approval legislation in force, is that the driver only needs to be informed of a significant emission relevant failure or in case of a default mode triggered by the powertrain software that significantly reduces propulsion unit torque. For other failure cases the EU proposed the manufacturer to decide whether or not the MI should be activated for malfunctions that are properly addressed by well-designed back-up modes by making use of powertrain system redundancy and:
- (i) That compensate for the malfunction in terms of preventing tailpipe emission levels exceeding harmonized OBD emission thresholds. In this case it is assumed that a well-designed back-up mode mitigates the tailpipe emission increase from one or more malfunctions; and/or
  - (ii) Prevents a significant propulsion unit torque loss, e.g. more than 10% of normal torque after the OBD system has activated a back-up mode to protect the driver or the vehicle's powertrain. In case of failure the OBD system might activate such a back-up mode that may not be noticeable by the driver under certain driving conditions. For this case, e.g. an OBD tell-tale on the instrument cluster could be illuminated to warn the driver of an anticipated, abnormal drive-ability;
- (b) Activation of the MI would therefore have been partially decoupled from storing diagnostic information in the powertrain controller's memory. Diagnostic information storage and availability upon request of a generic scan tool would have remained mandatory as prerequisite to effectively and efficiently repair the vehicle. The underlying justification of the EU proposal was to confront drivers as little as possible with the activated MI and to provide incentives to manufacturers to design excellent back-up and default modes to mitigate the adverse effects of a vehicle failure. Nevertheless, this methodology ensures that the diagnostic information is conveniently available to a repairer, free of charge and without technical constraints, which should help to level the playing field in the repair market. Again, it is assumed that a well maintained motor vehicle on which faults, if any, can easily be detected and diagnosed will result in lower emissions and a higher level of functional safety;
- (c) Other Contracting Parties wished to deal with electric / electronic circuit diagnostics as digital faults (fault or no fault) and perceived the proposed performance requirements as too complex in this first stage. China was interested in developing simple diagnostic functionality and stepping-up requirements in complexity in due course following technical progress. India proposed additional grades of OBD complexity within OBD stage I allowing a minimum common denominator of requirements to be available to all Contracting Parties. Several iteration rounds of discussions have been held and proposals assessed but in the end it was decided to harmonize the requirements as much as possible allowing sufficient flexibility to apply the OBD requirements so as to ensure each Contracting Party to implement the harmonized requirements to satisfy national or regional needs. The EPPR IWG decided to compile a flow chart with recommended scenarios, based on

a proposal from Japan, to deal with this complexity in the first stage and to incorporate this chart in the explanatory part of the UN gtr. In the future, upon need and if desired by Contracting Parties this flow chart can then be further developed covering increased harmonization of functionality.

14. Test type VIII, harmonized environmental verification testing of OBD:
  - (a) Owing to the fact that when implementing OBD stage I there are some Contracting Parties requiring harmonized tailpipe emission verification test procedures and that such requirements may be needed for all Contracting Parties in the future when developing enhanced diagnostic requirements in a future OBD stage II, the EPPR IWG could agree on optional provisions allowing to harmonize such an environmental verification test procedure. The starting point of this harmonized verification test procedure for two- and three-wheeled vehicles has been Annex 1 to chapter 11 of Regulation No. 83;
  - (b) In basic terms the fault under assessment is induced or simulated on a test vehicle which is subsequently run in a test type I emission laboratory cycle, applicable under national or regional requirements. The objective of test type VIII, which is a special test type I that in future might be harmonized as the WMTC set out in UN gtr No. 2, is to verify if the OBD system has detected the failure in time, stored the appropriate DTC and freeze frame. It offers also the possibility to assess the MI activation strategy and back-up mode activation, e.g. within one key cycle for certain malfunctions or within three key cycles for lesser urgent malfunctions or those requiring more data sampling to prevent false DTCs.
15. Reference fuel:
  - (a) Another horizontal issue for all EPPR UN gtrs in development has been the reference fuel specifications. The relevant questions were among others:
    - (i) Which types of reference fuels should be prescribed, all regional fuel types or just a reduced set?;
    - (ii) If the reference fuel has to be blended with ethanol or not?;
    - (iii) If the reference fuel specifications could be centrally stored in a repository like e.g. in a revised UN gtr No. 2 or as for example an annex of a mutual resolution?;
  - (b) Similar to the outcome of the discussions on a new UN gtr setting out requirements for two- and three-wheeled motor vehicles with respect to crankcase and evaporative emissions, the EPPR IWG decided that for the moment it is appropriate not to harmonize the reference fuel specifications yet. However, the EPPR IWG strongly recommended using the same test fuel specification for type VIII environmental OBD verification testing as also used for type I tailpipe emissions after cold start testing. It was decided to collect scientific data and to assess what the impact of the different fuel characteristic parameters may be in case of type VIII, environmental OBD verification testing. When sufficient scientific data is available and if deemed acceptable the EPPR IWG will undertake efforts to reduce the number of reference fuels and amend the UN gtr accordingly in due course.
16. Administrative provisions

Owing to the difference in views between the EPPR IWG members on the objectives and the need in split of information between diagnostic data and repair and maintenance information the initially proposed administrative provisions were



assessed in depth, debated and revisited. The EPPR IWG managed to agree on the administrative provisions, despite the many controversial discussed subjects in the substantial requirements. Again, these provisions are regarded as minimum requirements and leave the flexibility to Contracting Parties to require the vehicle manufacturer to provide supplemental data and information. It was agreed to regularly review these provisions and to supplement them following technical progress and future enhancements of the UN gtr.

17. Harmonized OBD engine load variable

The European Commission introduced the idea of a harmonized OBD engine load variable which was considered out of scope of OBD I. Today it is hardly possible for parties other than the vehicle manufacturer to understand in which engine speed – engine load area an engine is running, relative to the maximum engine load that is typically achieved at wide open throttle, when e.g. a vehicle is tested in an emission laboratory test or under real world conditions. Being able to identify the engine load allows the legislator and enforcement authorities to comprehend which engine speed – engine load area is not sampled in regulatory testing. This helps authorities to estimate the caveats of environmental testing in approval of the vehicle or during in service conformity testing if applicable and to explain why there might be gaps between criteria pollutant emissions and fuel consumption in the emission laboratory testing and under real world conditions<sup>3</sup>.

The proposed common OBD engine load variable was carried over from Regulation No. 83, chapter 11, definition 2.13., calculated load value. Despite the fact that the OBD engine load variable is based on airflow it is not necessary that a vehicle for that purpose is equipped with an expensive airflow sensor. The airflow is typically mapped in the development process of the engine on the dynamometer and subsequently calibrated in the powertrain control software. In dependence of the applicable load variable on-board of the vehicle, e.g. throttle position or MAP sensor reading, this unit-less, calculated OBD engine load variable can easily be predicted and be made available through the data link interface. The advantages of being able to continuously read a common available engine load variable largely outweigh the claimed disadvantages such as increased cost of software development, engine mapping and calibration for the manufacturer.

18. Definition and provision on "useful life"

The need for a definition of "useful life" has been debated at length in the EPPR IWG. Based on coherence with UN gtr Nos. 4, 5 and 11 the EPPR IWG decided to include a definition as well as a provision in the draft UN gtr in order to clarify during which time frame or accumulated distance and under which conditions the on-board diagnostic requirements have to be complied with by the motor vehicle type represented by the tested parent vehicle used in the approval process of the vehicle type. It was decided to specify this in a common way between all the draft UN gtrs in the scope of work of the EPPR IWG.

19. Temperature unit °C vs K

Indication of harmonized temperature unit (WLTP-09-19e) based on DIN EN ISO 80000-5. In summary:

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<sup>3</sup> For the technical relevance and more detailed explanation please refer to the JRC report: "Preparatory work for the Environmental Effect Study on the Euro 5 step of L-category vehicles", ISBN 978-92-79-57248-7 (print) or ISBN 978-92-79-57247-0 (pdf)

- i. define 0° C as 273.15 K;
  - ii. use "°C" for definition of temperatures;
  - iii. use Kelvin (with xxx.15) in calculations;
  - iv. delete redundant information where possible: ~~± 5 K~~ (± 5 °C) (Example).
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