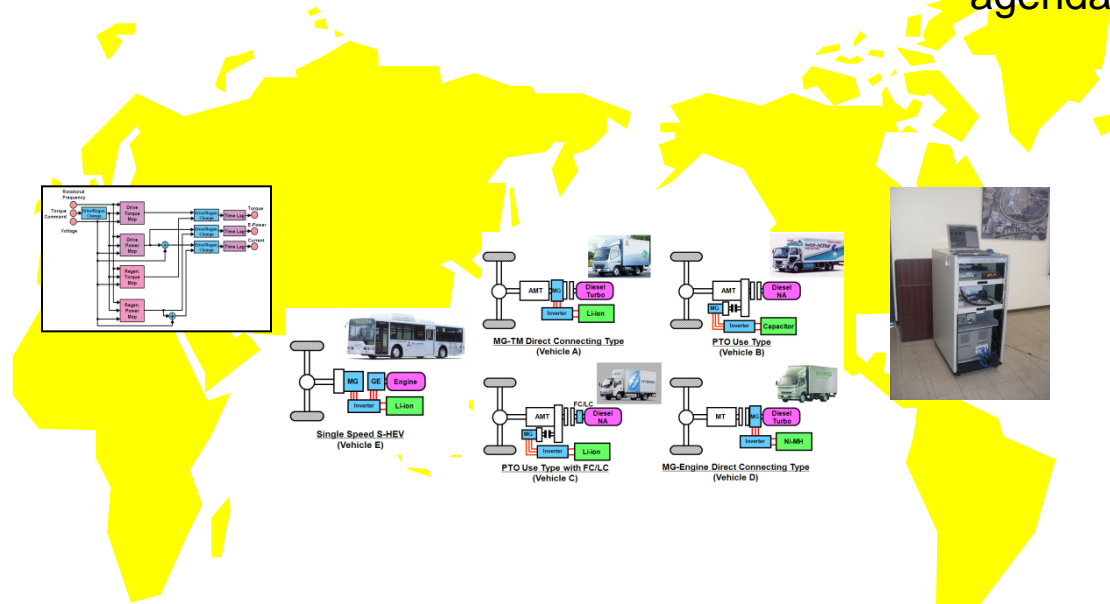




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Informal document No. **GRPE-68-14**  
(68th GRPE, 07 - 10 January 2014,  
agenda item 4(a))



# GRPE Informal Working Group on Heavy Duty Hybrids

Report to GRPE 68  
Geneva, 09 January 2014



# Contents

- **Summary of the 15th and 16th HDH meetings**
- **Status of HDH validation test program 2**
- **Open issues list**
- **Status of drafting group**
- **Presentation of informal document GRPE 68-12**
- **HDH timeline, roadmap & project planning**
- **Next meetings**



# Summary of 15th HDH Meeting

- **The results of the 15th meeting in San Francisco on 24 and 25 October 2013 are summarized, as follows:**
- **The results of validation test program 1 with the new model structure were presented by the institutes; the new model structure includes a comprehensive component model library, a new signal naming convention and restructured vehicle models**
  - **The next model release is foreseen for 31/10/2013**
  - **No further input on chassis dyno testing has been made; the final decision should be taken at the 16th HDH meeting**
  - **Validation test program 2 at JRC has started in May; so far, the validation criteria of the Japanese regulation could not be met; further work is needed.**
  - **Institutes and JASIC will jointly develop a proposal for fixed slopes**
  - **A specific procedure for plug-in hybrids will not be included**
  - **The OICA proposal on vehicle parameters was agreed**
  - **Weighting factors will not be included**
  - **Discussion on master ECU will continue**
  - **Discussion on work (engine or system) for the emissions calculation will continue at the 16th meeting**
  - **The technical secretary of HDH drafting group has been nominated**
  - **The drafting group will work hard to have the informal document ready for the 68th GRPE**



# Summary of 16th HDH Meeting

- **The results of the 16th meeting in Geneva on 07 January 2014 are summarized, as follows:**
- **Model version 0.5 was released and some comments received; still minor improvements necessary**
  - **Chassis dyno testing will not be included in this gtr amendment**
  - **Evaluation of validation test program 2 will continue until April 2014 (details see page 5); EPA asked for a transparent validation process incl. availability of detailed test results**
  - **As regards the drive cycle, institutes and JASIC have agreed on the fixed slope minicycle approach; implementation is ongoing with final approval foreseen at 17<sup>th</sup> HDH meeting**
  - **Definition of rated power for a hybrid system still under discussion**
  - **US EPA raised concerns with the timeline of the current mandate, while Japan supported November 2014 WP.29 adoption in order to have time for transposition into the post-JP09 regulation planned for 2016; EU COM also supported November 2014 adoption, but indicated that further discussion is needed on EU implementation**
  - **Approval procedure for OEM specific models must be defined more clearly**
  - **Discussion on hardware control functions (master ECU) will continue**
  - **While Japan and OICA support total system work as basis for emissions calculation, other CPs have not finalized their position yet. EU-COM and some EU CPs raised reservations; discussion among EU CPs will follow.**
  - **Provided that the ongoing activities deliver according to the expectations, the group expects that the timeline can still be met**
  - **Due to the open issues (details see page 6), there remains a risk that the work program will not be finalized in time**



# Status of Validation Test Program 2

## ➤ JRC test program

- Validation test program 2 with real HVs started at JRC with in May 2013
- Test with two vehicles (Volvo & MAN) completed
- Iveco vehicle will be tested at JRC in February 2014 with torque measurement device installed on vehicle
- Additional dyno testing of MAN vehicle at MAN in January 2014
- So far, problems encountered to meet Japanese verification criteria
- Data evaluation and problem solution still ongoing
- Validation expected to be completed by the end of March 2014

## ➤ Consequences

- Timely validation is a prerequisite for HDH adoption
- If validation fails or open issues are not solved to the satisfaction of the group, extension of the mandate will be requested at GRPE 69



# Open Issues

- **Evaluation of validation test program 2**
- **WHVC road gradients (agreed, implemented by March 2014)**
- **HILS verification criteria**
- **Approval procedure for OEM specific models**
- **Basis for brake specific emissions calculation (system work vs. engine work)**
- **Definition of hardware hybrid control functions or master ECU**
- **Hybrid system family concept**
- **HILS testing**



# Drafting Group

## ➤ Status

- Two meetings in March and May 2013 w/o technical secretary
- Technical secretary was installed in September 2013
- The 3rd meeting was held on 22 and 23 October 2013 in San Francisco
- The 4th to 6th meetings were held in November/December 2013 as web meetings
- The 7th meeting was held on 18 December 2013 in Brussels

## ➤ Further procedure

- The drafting group will continue to work until April/May 2014
- 2 further web meetings planned in January/February 2014
- Next face-to-face meeting on 18/19 February 2014 in Tokyo



# Overview Informal Document 68-12

- **The following approach was taken for amendment 3 to gtr n° 4**
  - Preparation of a consolidated version of gtr n° 4 (amendments 1 & 2)
  - New annexes 8 (HILS) & 9 (powertrain test)
  - Addition of WHVC with road gradients to annex 1
  - Amendments to base regulation, where necessary, such as
    - definitions
    - hybrid powertrain family
    - general test procedure
    - stop/start approach
  
- **In addition, the secretary (former WHDC secretary) is asking to further align gtr n° 4 with gtr n° 11**
  - Focus on calibration protocols and description of test equipment
  - Not yet included in GRPE-68-12





# Informal Document 68-12

## Definitions

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- **Hybrid related definitions have been added to § 3.1, which are aligned with the current VPSD draft, as far as possible**
- “drivetrain” means the connected elements of the powertrain downstream of the final energy converter
  - “energy converter” means the part of the powertrain converting one form of energy into a different one
  - “energy storage system” means the part of the powertrain that can store chemical, electrical or mechanical energy, and which can be refilled or recharged externally and/or internally
  - “generator” means an energy converter transferring mechanical energy into electric energy
  - **“hardware-in-the-loop simulation (HILS)” means real time hybrid vehicle simulation running on a computer where a hardware component interacts with the simulation through an interface**
  - “hybrid vehicle” means a vehicle with a powertrain containing at least two different types of energy converters and two different types of energy storage systems
  - “powertrain” means the combination of energy storage system(s), energy converter(s) and drivetrain(s) [for the purpose of vehicle propulsion], **and the communication interface (hardware and messages) among the powertrain or vehicle control units**
  - “rechargeable energy storage system (ReESS)” means a system storing energy carriers other than fuels
  - **“ReESS subsystem” means any functional assembly of ReESS components**
  - “stop/start system” means automatic stop and start of the internal combustion engine to reduce the amount of idling



# Informal Document 68-12

## Hybrid Powertrain Family

### 5.3.3. Parameters defining the hybrid powertrain family

#### 5.3.3.1. Internal combustion engine

- (a) ....
- (b) ....

#### 5.3.3.2. Energy converter

- (a) Electric
- (b) Hydraulic
- (c) Other

#### 5.3.3.3. ReESS

- (a) Electric
- (b) Hydraulic
- (c) Other

#### 5.3.3.4. Transmission

- (a) Manual
- (b) Automatic
- (c) Dual clutch
- (d) Other

#### 5.3.3.5. Hybrid control strategy

**The manufacturer shall present the technical elements explaining the grouping of hybrid powertrains in the same family, i.e. the reasons why these powertrains can be expected to satisfy the same emission requirements.**

**These elements can be calculations, simulations, estimations, description of the hybrid ECU, experimental results, etc.**



# Informal Document 68-12

## General Approach

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### b) WHVC VEHICLE SCHEDULE

<i>Time</i>	<i>Vehicle Speed</i>	<i>Road gradient</i>	<i>Time</i>	<i>Vehicle Speed</i>	<i>Road gradient</i>	<i>Time</i>	<i>Vehicle Speed</i>	<i>Road gradient</i>
<i>s</i>	<i>km/h</i>	<i>%</i>	<i>s</i>	<i>km/h</i>	<i>%</i>	<i>s</i>	<i>km/h</i>	<i>%</i>
0?	0	0	0	0	0	0	0	0

#### 7.2.3. Transient test cycle WHVC (hybrid powertrains only)

The transient test cycle WHVC is listed in Appendix 1b as a second-by-second sequence of vehicle speed and road gradients. In order to perform the test on an engine or powertrain test cell, the cycle values need to be converted to the reference values for rotational speed and torque for the individual engine under test in accordance with either method in sections 7.2.3.1. or 7.2.3.2.

HEC  
HPC

Hybrid engine cycle  
Hybrid powertrain cycle

It should be noted that the test cycles referred to as HEC and HPC in this gtr are not standardized cycles like the WHTC and WHSC, but test cycles developed individually for each hybrid powertrain from the WHVC.

#### 7.6. WHTC cycle run

This paragraph also applies to the HEC and HPC test cycles of hybrid vehicles. Different cycles for the cold start and hot start are permitted, if it is the result of the conversion procedure in annex 8 or annex 9.

#### 7.6.5.1. Stop/start system

If a stop/start system is used or if the hybrid engine cycle requires an engine stop, the engine shall be turned off at idle and/or motoring points, as commanded by the engine ECU. Emissions measurement and data collection shall continue until the end of test cycle.



# Informal Document 68-12

## Annex 8

### REQUIREMENTS FOR ENGINES INSTALLED IN HYBRID VEHICLES USING HILS METHOD

#### 1. SCOPE

This annex shall apply to HVs, which are equipped with an internal combustion engine as one of their energy converters and for which the pollutant emissions shall be determined on the basis of an engine test.

#### 2. TEST PROCEDURE

##### 2.1 HILS method

The HILS method consists of running the internal combustion engine on the test bench (in accordance with the conventional engine test procedures) using the HV engine test cycle determined through following steps (and visualized in Figure X):

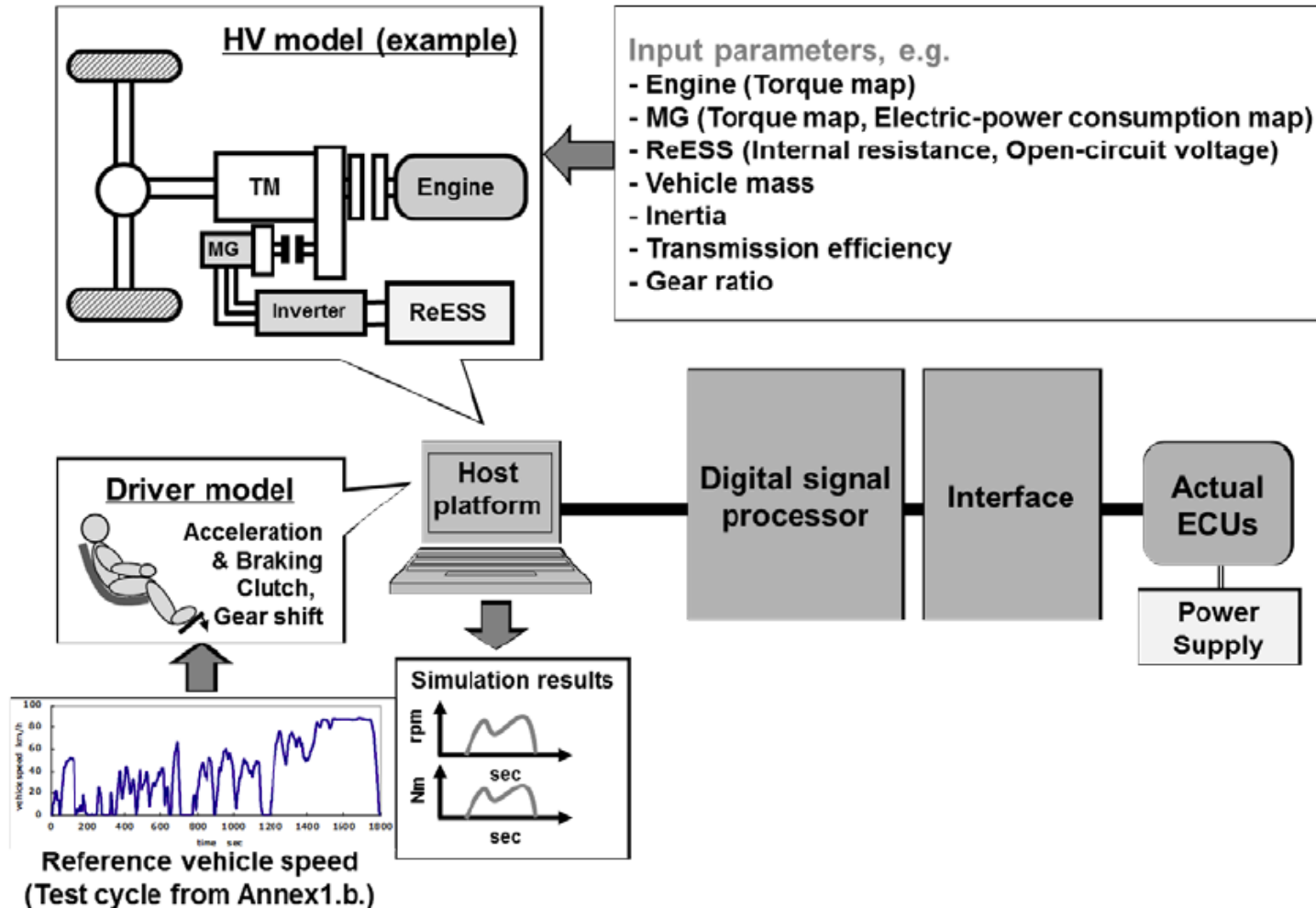
- 1) Confirmation of the object for approval
- 2) Define the input parameters for the HV components in accordance with Paragraph A.8.3.8. and the Component Test Procedure of Paragraph A.8.4.
- 3) Build the HILS system according to Paragraph A.8.3. and check its operation according to Paragraph A.8.7.
- 4) Setup the HILS system with the HV model in accordance with Paragraph A.8.3.4.
- 5) Verify the HV model operation in accordance with Paragraph A.8.6.
- 6) Conduct the HILS simulated run in accordance with Paragraph A.8.5. and determine the engine test cycle.
- 7) Conduct the exhaust emission test in accordance with Paragraph Y.Y.



# Informal Document 68-12

## Annex 8 – Principal Procedure

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# **Informal Document 68-12**

## **Annex 9**

### **REQUIREMENTS FOR ENGINES INSTALLED IN HYBRID VEHICLES USING POWETRAINS METHOD**

#### **1. SCOPE**

**This annex shall apply to HVs, which are equipped with an internal combustion engine as one of their energy converters and for which the pollutant emissions are to be determined on the basis of a powertrain test.**

#### **2. TEST PROCEDURE**

**This Annex describes the procedure for simulating a chassis test for a pre-transmission or post-transmission hybrid system in a powertrain test cell. Following steps shall be carried out:**



# Informal Document 68-12

## Non-HDH Related Amendments

- **When adopting gtrs n° 4 and n° 11, alignment could not be completed, but is still desirable to be improved**
  - **Amendment 3 to gtr n° 4 offers this opportunity**
  - **It is assumed that these amendments do not require specific WP.29 approval**
  - **The proposed amendments will not change gtr n° 4 in essence, but focus on improvements of the calibration protocols**
  - **The amendments are not yet included in GRPE-68-12, but the sections affected are marked, as shown below**

### **9.1. Dynamometer specification**

- **The proposed alignment offers an evident advantage to engine/vehicle manufacturers, test laboratories and type approval authorities who deal with both on-highway and nonroad engines**
- **GRPE is asked to endorse the proposal**



# HDH Timeline

- **The HDH group proposes the following timeline to GRPE:**
  - **Informal document GRPE-68-12 is presented to GRPE 68 for consideration; it includes text finalized by December 2013**
  - **The formal document for GRPE 69 will be based on informal document GRPE-68-12**
    - ❖ **it will include the drafting progress and those items of the open issues list on page 6 resolved by 01/03/2014**
  - **An informal document will be submitted to GRPE 69 by 15/05/2014, which will**
    - ❖ **include the drafting progress after March 2014 and the remainder of the open issues list**
    - ❖ **complement the formal document submitted in March 2014**
  - **After adoption of both documents by GRPE 69, a consolidated document will be provided to WP.29 for approval**
  - **The technical report can only be submitted as an informal document to GRPE 69, since the work program will not be completed by March 2014**
- **GRPE is asked to agree to the proposal**
- **HDH is aware that there remains a risk of not being able to meet this timeline**
  - **In that case, an extension of the mandate would be requested at GRPE 69**







# Next Meetings

- **The next HDH meetings are scheduled as follows:**
  - **The 17th meeting will be on 08 and 09 April 2014 in Madrid**
  - **The 18th meeting will be on 03 June 2014 in Geneva (to be confirmed)**
  
- **The next drafting group meetings are scheduled as follows:**
  - **The 8th meeting will be on 27 January 2014 (web meeting)**
  - **The 9th meeting will be on 10 February 2014 (web meeting)**
  - **The 10th meeting will be on 18 and 19 February 2014 in Tokyo**
  - **Further web meeting(s) in March 2014**
  - **The final meeting will be on 10 and 11 April 2014 in Madrid**
  - **Further web meeting(s) in April/May 2014, if needed**
  
- **GRPE is asked to**
  - **Reserve a half day for the 18th HDH meeting during the 69th GRPE session in June 2014**