

THIRTEENTH MEETING OF THE GRPE INFORMAL GROUP ON HEAVY DUTY HYBRIDS (HDH)

Borlänge, 21 to 22 March 2013

MINUTES OF THE MEETING

Venue: Trafikverket ICT, Jussi Björlings Väg 2

Chairman: Petter Åsman (Sweden)

1.- WELCOME AND INTRODUCTION

The Chairman welcomed the participants.

2.- ADOPTION OF THE DRAFT AGENDA

(Working paper HDH-13-02e)

The draft agenda was adopted.

3.- DRAFT MINUTES OF THE TWELFTH MEETING

(Working paper HDH-12-07-Rev1e)

The draft minutes of the 12th meeting were approved.

4.- CONTRIBUTIONS FROM STAKEHOLDERS

4.1 Hybrid and GHG activities

(Working paper HDH-12-05-Rev1e)

The original working paper HDH-12-05e was uploaded to the HDH website, but not presented at the 12th meeting. Mr. Lee (KATRI) presented a revised version at this meeting. Korea is currently investigating to replace the existing fuel economy regulation, which is based on a 60 km/h constant speed driving on a chassis dyno, with the WHVC cycle. Analysis of driving conditions showed a good correlation between typical Korean driving patterns and the WHVC. As a first step, Korea plans to introduce the WHVC chassis test into the national fuel economy regulation. As a second step, Korea intends to adopt the HILS method as an option upon completion of the gtr.

4.2 Comments on HDH work program

4.2.1 Calculation of slopes on WHVC

(Working papers HDH-13-06e, HDH-13-08e)

Mr. Morita (JARI) presented working paper HDH-13-08e on methods for matching integrated power values of WHTC and WHVC. At the 11th HDH meeting, it was shown that calculation

of instantaneous slopes resulted in very steep slopes of up to 40% and could therefore not be used for the HILS simulation. When applying a 3 second moving average for curve smoothing, slopes could be reduced, but slopes of approx. 30 % were still present (page 7). Only by applying a 30 second moving average, slopes could be reduced to realistic levels of max. 10 % (page 8). Another approach is the calculation of a constant slope, which resulted in this example as 1.13 %. However, a constant positive slope is neither realistic nor favorable for hybrid vehicles. It was concluded that a 30 second moving average would be the best approach.

Mr. Osaki (JASIC) presented working paper HDH-13-06e. This presentation also deals with the calculation of slopes for the WHVC, but used a slightly different method than JARI. The method is described on pages 3 to 5, and was tested for two different vehicles (26 t / 317 kW and 5 t, 96 kW). Like with JARI, a constant slope approach was compared to a 30 second moving average approach. The constant slope was 0.35 %, while the 30 second moving average resulted in slopes between - 1.9 % and + 3.9 % for the heavy vehicle and + 6.5 % for the light vehicle, respectively. The correlation between power patterns and torque patterns on the traction side is slightly better with the 30 second moving average, while the traction and braking cycle work is slightly better with the constant slope (pages 6, 7). Overall, JASIC considers the 30 second moving average as the more favorable approach.

The difference between the constant slopes of 1.13 % vs. 0.35 % was considered to be due to the different calculation methods. From the test results it became clear that the slopes vary depending on the vehicle. It was therefore discussed whether the slope should be fixed in the gtr or calculated for the individual vehicle. No conclusion could be reached on this topic, but the IWG members agreed that slopes need to be added to the WHVC.

4.2.2 Presentation by OICA

(Working paper HDH-13-05e)

Mr. Berg presented working paper HDH-13-05. He confirmed that three vehicles will be available for validation test program 2, a serial hybrid bus from MAN, a parallel hybrid bus from Volvo, and a parallel hybrid medium heavy duty truck from Iveco. The verification criteria of the Japanese regulation will be used. Due to the tight time frame, SILS will be used in this program, as agreed at the 12th HDH meeting.

OICA supports the re-structuring of the models, as proposed by the institutes. For the OEMs, it is essential that the generic HILS models may be replaced with OEM specific models for better accuracy and better compatibility with OEM specific control units. OICA also supports the option of powerpack testing in the gtr. Finally, a procedure should be defined to convert high frequency HILS output signals into lower frequency engine dyno input signals.

4.2.3 Consideration on cold start

(Working paper HDH-13-07e)

Mr. Morita presented working paper HDH-13-07. In order to cope with the cold start test required in the gtr, TU Graz developed thermal models that may be used in the HILS process. JARI is proposing a simpler approach, which is based on adding a predicted temperature profile to the interface model. This would not require any changes to the current model, but cannot be used for temperature changes of battery or motor/generator.

5.- ASSESSMENT OF POWERPACK TESTING
(Working paper HDH-13-12e)

Mr. Sanchez (EPA) gave an overview of the current EPA activities.

He emphasized that transmissions are becoming more important in the evaluation of hybrid vehicles. A post-transmission powerpack method therefore is suitable test method. He indicated that EPA will give their input to the HDH drafting group. EPA is willing to test within their internal programs the WHVC with slopes, but powerpack validation will likely be used instead of chassis dyno validation.

6.- ASSESSMENT OF CHASSIS DYNO TESTING

No discussion took place.

7.- HDH VALIDATION TEST PROGRAMS

7.1 Presentation by research institutes on validation test program 1
(Working paper HDH-13-03-Rev1e)

Working paper HDH-13-03e is a joint presentation of the three institutes tasked with conducting validation test program 1.

Mr. Six started with a general overview of the progress achieved (pages 3 to 12). He then presented the structure of the thermal models. The battery model was optimized and can be used for capacitor, as well.

Prof. Fredriksson presented the new model structure (pages 13 to 27). Task was to set up a data bus system in the model that allows various combinations of engines, gear boxes and energy storage systems. With the current Japanese open source model, it is difficult to set up such data bus system. Therefore, the models need to be restructured. Two types of interfaces are proposed, the physical interface that is related to how different components are connected physically, and the signal interface that is related to the control/sensor signals needed for the ECUs. For the gtr, the physical interface should be specified, while for the signal interface only a minimum set of signals can be specified. If other signals or more complex models are needed for the simulation, it will be possible for OEMs to include those without affecting the model structure.

The new model structure will be made available by the end of April for testing. Comments are essential to improve the model.

Mr. Six then went on with the drive cycle investigations (pages 28 to 38). Rationale was to develop a method for the WHVC with slopes (also proposed by Japan in 4.2.1) to produce similar emissions results than on the WHTC for conventional vehicles. The method divides the WHVC into mini-cycles and calculates for each mini-cycle the WHTC/WHVC work difference and transforms it into average mini-cycle slopes (page 32). Emissions results based on simulation look promising. It was decided to check both the 30 sec average slope according to Japanese proposal and mini-cycles approach during validation test program 2. The mini-cycle calculation tool will be uploaded to the HDH website.

Mr. Silberholz presented under test methodology investigations the major items that need to be decided for the gtr (pages 39 to 48). He proposed that OEM specific models should be permitted. He further proposed to use on-road measurements for model verification rather

than chassis dyno tests. Another item is the gear shift duration that is not included in the Japanese model. EPA is concerned that the HILS cycle might be less transient than in the vehicle. Since most of the issues are questions/proposals for further evaluation, they are handled under 7.2.

7.2 Discussion

(Working paper HDH-13-03-Rev1e)

Page 40: it was agreed that the use of OEM specific models should be allowed. However, validation and verification of such models need to be ensured for the gtr.

Page 41: standardized component tests will remain in the gtr, but further discussion is necessary, if OEM specific component tests are needed.

Page 42: model verification by means of on-road tests will be investigated during validation test program 2. Powertrain verification will be added.

Page 43: OEM specific interface model need to be approved by TAA during certification process. Further discussion on what can/cannot be included in interface model is needed.

Page 44: multiple ECUs have been on the screen for quite some time. It was agreed that a master ECU would need to be defined, with supportive ECUs to be integrated via interface or software emulation.

Page 45: boundary conditions for re-certification need to be defined in the gtr; but the issue will have to be finally solved between OEM and TAA.

Page 46: information document is outside the scope of the gtr, will be handled by regional authorities.

Page 47: vehicle independent emissions certification will be discussed after validation test program 2.

Page 48: signal frequency will be discussed later; 1 Hz, 10 Hz, 50 Hz will be investigated during validation test program 2.

7.3 Transmission model VECTO

(Working paper HDH-13-04e)

Prof. Hausberger presented working paper HDH-13-04. The model was developed by TU Graz in the context of the EU heavy duty CO2 program. It was generally agreed that a generic gearbox model should be included in the gtr that might be replaced with an OEM specific model. Feedback on the VECTO approach is requested by the end of April.

7.4 Planning of validation test program 2

(Working paper HDH-13-03-Rev1e)

Prof. Hausberger presented the proposal of the institutes for validation test program 2 (pages 49 to 54). He indicated that TU Graz was able to do the vehicle testing. It was however agreed to accept the offer from JRC to do the vehicle testing and the overall organization. It was further agreed that the institutes should do the final evaluation of the HILS method, since they had done most of the development work.

Testing will start with the Volvo parallel hybrid bus in early May, followed by the MAN serial hybrid bus in early June and the Iveco parallel hybrid truck around the end of June. The OEMs are asked to arrange for a meeting among themselves and JRC to set up a test program and timetable. JRC will be responsible for the coordination of the program. Chassis dyno testing will be done with emissions measurement, on-road testing in accordance with the PEMS rules, but w/o emissions measurement. Engine testing on HILS cycle will be done at OEMs premises.

EPA requested to get the vehicle specifications. EPA further requested to receive an ECU for HILS testing. The Chairman encouraged bilateral discussions between EPA and OICA to solve the issue before the 14th HDH meeting.

8.- DEVELOPMENT OF THE GTR

8.1 Report from the drafting group

The Chairman gave a brief report from the meeting of the HDH drafting group on the two days before the 13th HDH meeting. It was agreed and confirmed that the HILS method would be developed as an annex to gtr n° 4. Starting point is the Japanese regulation. Modifications to the Japanese regulation and any additional items (e.g. thermal models) would be included based on the input from the HDH work program. Unfortunately, the technical secretary responsible for the editorial work has not yet been nominated, but the EU Commission is hoping to solve the problem, soon.

Due to the meanwhile very tight timetable, the drafting group will need to call for web/phone meetings between the face-to-face meetings.

8.2 Re-structuring of gtr n°4

The secretary briefly introduced the first very rough draft that he had prepared for the meeting of the drafting group. The details of the HILS method will be incorporated into a new Annex 8 to gtr n°4. For the time being, this Annex is also planned to include the powerpack test procedure. However, it might be more appropriate to provide for a separate Annex. This issue will be further discussed.

8.3 General contents

In general, the content will largely follow the Japanese procedure for HILS and the EPA procedure for powerpack testing. The drafting group will only include items into the gtr that have been approved by the IWG. For a transparent process, the draft versions prepared by the drafting group will be uploaded to the HDH website for review by the IWG members, whenever a new draft is available. Any editorial comments should be submitted to the technical secretary (to be nominated), any other comments to the IWG for discussion.

9.- ROAD MAP AND PROJECT PLANNING

(Working paper HDH-13-09e)

The secretary presented working paper HDH-13-09. There is no change to the roadmap agreed at the 12th HDH meeting. The secretary reminded that the timetable can only be met if the technical secretary of the drafting group can be installed, soon.

10.- NEXT MEETINGS

The next HDH meetings will take place, as follows

- 14th HDH meeting: 04 June 2013, Geneva
- 15th HDH meeting: 24 and 25 October 2013, San Francisco, USA
- 16th HDH meeting: January 2014, Geneva (date to be confirmed)

The next meetings of the drafting group (HDH-DG) will take place, as follows

- 2nd HDH-DG meeting: 29 May 2013, Brussels
- 3rd HDH-DG meeting: to be decided at 2nd meeting

- 4th HDH-DG meeting: 22 and 23 October 2013, San Francisco

11.- SUMMARY AND CONCLUSIONS

Chairman and secretary summarized the meeting as follows:

- The basic vehicle cycle will be the WHVC with road gradients; 2 methods for calculating the road gradients will be investigated
- The institutes propose that the model structure allows for using OEM specific models
- The institutes will communicate the deliverables of validation test program 1 and the related time schedule within the next two weeks (see working paper HDH-13-10e)
- The new model structure will be available by the end of April
- The VECTO transmission model by TU Graz will be added to the open source model
- Master ECU needs to be defined, supportive ECUs via interface or software emulation
- Validation test program 2 will start in May with Volvo parallel hybrid bus, followed by MAN serial hybrid bus and Iveco parallel hybrid MD truck
- Chassis dyno tests and road tests (w/o emissions measurement) will be run at JRC, engine dyno tests at OEM
- Command signal frequency for engine tests will be 1 Hz, 10 Hz, 50 Hz
- OICA and EPA will discuss bilaterally the possibility of HILS testing at EPA and report at the 14th HDH meeting
- Model verification will be investigated during validation test program 2 including powertrain verification
- The hybrid test procedure will be developed as an amendment to gtr n° 4 by introducing a new Annex 8, which
 - a. will include HILS method based on JP regulation Kokujikan 281 and input from HDH development
 - b. will include powertrain method based on US-EPA procedure

12.- OTHER BUSINESS

None.

The participants thanked the Chairman for the excellent meeting arrangements and the memorable tour through the world heritage Falun copper mine.
